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Report No: PAD2577

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN

IN THE AMOUNT OF US$120 MILLION

TO THE

UNITED MEXICAN STATES

FOR A

WATER SECURITY AND RESILIENCE FOR THE VALLEY OF MEXICO PROJECT

(PROSEGHIR)

February 4, 2020

Water Global Practice
Latin America and Caribbean Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective January 24, 2020)

Currency Unit = Mexican Peso (MXN)

18.77 MXN = US$1.00

1.00 MXN = US$0.053

FISCAL YEAR
January 1 - December 31

Regional Vice President:	J. Humberto Lopez (Acting)
Country Director:	Pablo Saavedra
Regional Director:	Anna Wellenstein
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Task Team Leader(s):	Diego Juan Rodriguez, Hector Alexander Serrano

ABBREVIATIONS AND ACRONYMS

ANP	Protected Natural Area (*Área Natural Protegida*)
AWS	Automated Weather Station
BANSEFI	National Savings and Financial Services Bank (*Banco del Ahorro Nacional y Servicios Financieros*)
BdB	Wellness Bank (*Banco del Bienestar*)
CAEM	Water Commission of the State of Mexico (*Comisión del Agua del Estado de México)*
cm	Centimeter
CONAGUA	National Water Commission (*Comisión Nacional del Agua*)
COTEMA	Technical Groundwater Management Advisory Committee *(Comité Técnico de Manejo de Aguas Subterráneas)*
CNGP	The National Committee of Large Dams (*Comité Nacional de Grandes Presas)*
CPF	Country Partnership Framework
ESHS	Environmental, Social, Health and Safety
ESMF	Environmental and Social Management Framework
FM	Financial Management
GCM	General Circulation Models
GDP	Gross Domestic Product
GoM	Government of Mexico
GRS	Grievance Redress Service
IBRD	International Bank for Reconstruction and Development
IMTA	Mexican Institute for Water Technology *(Instituto Mexicano de Tecnología del Agua)*
IP	Indigenous Peoples
IPP	Indigenous Peoples Plan
IPPF	Indigenous Peoples Planning Framework
Km	Kilometer
LAC	Latin America and the Caribbean
l/s	Liters per second
m3	Cubic meter
m^3/s	Cubic meters per second
M&E	Monitoring and Evaluation
MAR	Managed Aquifer Recharge
NAFTA	North American Free Trade Agreement
O&M	Operations and Maintenance
OCAVM	Basin Agency for the Valley of Mexico (*Organismo de Cuenca Aguas del Valle de México)*
OP/BP	Operational Policy/Bank Procedures
PAI	Immediate Action Plan *(Plan de Acción Inmediata)*
PDO	Project Development Objective

PIU	Project Implementation Unit
PPSD	Project Procurement Strategy for Development
PROCYMI	Rehabilitation and Infrastructure Maintenance Program *(Programa de Conservación y Mantenimiento de la Infraestructura para la Prestación del Servicio de Abastecimiento de Agua Potable para la Zona Metropolitana del Valle de México 2014–2018)*
PROSEGHIR	Water Security and Resilience for the Valley of Mexico Project (*Proyecto de Seguridad Hídrica y Resiliencia para el Valle de México)*
RAP	Resettlement Action Plan
RAS	Reimbursable Advisory Services
RPF	Resettlement Policy Framework
RGAP	Regional Gender Action Plan
SA	Social Assessment
SACMEX	Mexico City Water Utility *(Sistema de Aguas de la Ciudad de México)*
SCADA	Supervisory Control and Data Acquisition
SHCP	Ministry of Finances and Public Credit – Secretaría de Hacienda y Crédito Publico
SIAFF	Integrated Federal Financial Administrative System *(Sistema Integral de Administración Financiera Federal)*
SICOP	Budget and Accounting System *(Sistema de Contabilidad y Presupuesto)*
SORT	Systematic Operations Risk-Rating Tool
SFP	Ministry of Public Administration *(Secretaría de la Función Pública)*
STEP	Systematic Tracking of Exchanges in Procurement
TESOFE	National Treasury *(Tesorería de la Federación)*
TFP	Total Factor Productivity
TMA	Toluca Metropolitan Area
TT	Task Team
UNAM	National Autonomous University of Mexico *(Universidad Nacional Autónoma de México)*
VMMA	Valley of México Metropolitan Area
WB	World Bank
WRM	Water Resources Management
WWTP	Wastewater Treatment Plant

BASIC INFORMATION

Country(ies)	Project Name	
Mexico	Water Security and Resilience for the Valley of Mexico (PROSEGHIR)	
Project ID	Financing Instrument	Environmental Assessment Category
P164389	Investment Project Financing	B-Partial Assessment

Financing & Implementation Modalities

[ ] Multiphase Programmatic Approach (MPA)	[ ] Contingent Emergency Response Component (CERC)
[ ] Series of Projects (SOP)	[ ] Fragile State(s)
[ ] Disbursement-linked Indicators (DLIs)	[ ] Small State(s)
[ ] Financial Intermediaries (FI)	[ ] Fragile within a non-fragile Country
[ ] Project-Based Guarantee	[ ] Conflict
[ ] Deferred Drawdown	[ ] Responding to Natural or Man-made Disaster
[ ] Alternate Procurement Arrangements (APA)	

Expected Approval Date	Expected Closing Date
27-Feb-2020	31-Dec-2025

Bank/IFC Collaboration

No

Proposed Development Objective(s)

The objectives of the Project are to improve the reliability of the Cutzamala System and strengthen the management of groundwater resources in the Valley of Mexico

Components

Component Name	Cost (US$, millions)
Improving Energy Efficiency and Resilience of the Cutzamala System	60.00

Groundwater Management and recharge pilot infrastructure in the Valley of Mexico	54.00
Institutional Strengthening and Project Management	6.00

Organizations

Borrower:	United Mexican States
Implementing Agency:	CONAGUA

PROJECT FINANCING DATA (US$, Millions)

SUMMARY

Total Project Cost	120.00
Total Financing	120.00
of which IBRD/IDA	120.00
Financing Gap	0.00

DETAILS

World Bank Group Financing

International Bank for Reconstruction and Development (IBRD)	120.00

Expected Disbursements (in US$, Millions)

WB Fiscal Year	2020	2021	2022	2023	2024	2025
Annual	0.67	6.55	12.75	28.13	37.60	34.30
Cumulative	0.67	7.22	19.97	48.10	85.70	120.00

INSTITUTIONAL DATA

Practice Area (Lead)

Water

Contributing Practice Areas

Climate Change and Disaster Screening

This operation has been screened for short and long-term climate change and disaster risks

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

Risk Category	Rating
1. Political and Governance	Moderate
2. Macroeconomic	Moderate
3. Sector Strategies and Policies	Moderate
4. Technical Design of Project or Program	Substantial
5. Institutional Capacity for Implementation and Sustainability	Moderate
6. Fiduciary	Moderate
7. Environment and Social	Substantial
8. Stakeholders	Moderate
9. Other	
10. Overall	Moderate

COMPLIANCE

Policy

Does the project depart from the CPF in content or in other significant respects?

[ ] Yes [✓] No

Does the project require any waivers of Bank policies?

[ ] Yes [✓] No

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment OP/BP 4.01	✓	
Performance Standards for Private Sector Activities OP/BP 4.03		✓
Natural Habitats OP/BP 4.04	✓	

Forests OP/BP 4.36		✓
Pest Management OP 4.09		✓
Physical Cultural Resources OP/BP 4.11	✓	
Indigenous Peoples OP/BP 4.10	✓	
Involuntary Resettlement OP/BP 4.12	✓	
Safety of Dams OP/BP 4.37	✓	
Projects on International Waterways OP/BP 7.50		✓
Projects in Disputed Areas OP/BP 7.60		✓

Legal Covenants

Sections and Description

Schedule 2. Section 1. A. To facilitate the implementation of Part 2 of the Project, the Borrower shall cause CONAGUA to maintain at all times during Project implementation a Groundwater Advisory Group with composition and functions acceptable to the Bank as set forth in the Operational Manual.

Sections and Description

Schedule 2. Section 1. D. Prior to carrying out any rehabilitation works or any Project activities that rely on a Cutzamala System Dam, but no later than twelve (12) months after the Effective Date, the Borrower shall cause CONAGUA to appoint a panel of independent experts (the Panel of Experts) with terms of reference and composition acceptable to the Bank, including the following responsibilities: (i) reviewing the risk-based dam safety assessments, the safety inspection reports, the operations and maintenance plans and the emergency preparedness plans, all for the Cutzamala System Dams; and (ii) advising on the design and implementation of rehabilitation works required for the Cutzamala System Dams; and (iii) reviewing the investigation, design and implementation of high-hazard cases involving significant and complex remedial works.

Sections and Description

Schedule 2. Section 1. D. Prior to carrying out any rehabilitation works or any Project activities that rely on a Cutzamala System Dam, the Borrower shall cause CONAGUA to: (i) undertake a risk-based dam safety assessment of said Cutzamala System Dam under terms of reference acceptable to the Bank; and (ii) submit to the Panel of Experts and to the Bank the results of said risk-dam safety assessment with contents acceptable to the Panel of Experts and to the Bank.

Sections and Description

Schedule 2. Section 1. D. No later than six months after the submission of a risk-based dam safety assessment for any of the Cutzamala System Dams, the Borrower shall cause CONAGUA to furnish to the Bank: (i) an operation and maintenance plan; (ii) an emergency preparedness plan, all for said Cutzamala System Dam and with contents

acceptable to the Bank; and (iii) therefore carry out said plans in accordance with their terms and in a manner acceptable to the Bank.

Conditions

Type	Description
Effectiveness	The Additional Condition of Effectiveness consists of the following, namely, that the Contrato de Mandato shall have been duly executed by the parties thereto and is in full force and effect. The Effectiveness Deadline is the date ninety (90) days after the date of the Loan Agreement (Article V of the Loan Agreement).
Type	Description
Disbursement	No withdrawal shall be made for payments made prior to the Signature Date of the Loan Agreement, except that withdrawals up to an aggregate amount not to exceed $24,000,000 may be made for payments made prior to such date but on or after the date falling twelve months prior to the Signature Date.

MEXICO
WATER SECURITY AND RESILIENCE FOR THE VALLEY OF MEXICO (PROSEGHIR)

TABLE OF CONTENTS

I. STRATEGIC CONTEXT

A. Country Context

1. **Mexico is an upper-middle income country with a diversified economy, but its moderate economic growth has limited significant poverty reduction and income convergence.** Growth averaged about 2 percent between 1980 and 2018, or close to 1 percent on a per capita basis. The country's per capita Gross Domestic Product (GDP) stands at 34 percent of U.S. per capita GDP, compared with 49 percent back in 1980. On average, over the last 25 years, Total Factor Productivity (TFP) growth has been negative. Moreover, regional inequality is high. The official multidimensional poverty rate fell from 44.4 percent of the population in 2016 to 41.9 percent in 2018, while the share of the population living below the monetary poverty line in 2018 was 48.8 percent, close to the level observed in 2008. After a decline in 2010–14, the annualized growth rate of median per capita income was 1.8 percent in 2016–18, still well below the average in the Latin America and the Caribbean (LAC) region.

2. **Public investment has been low, and the gaps in infrastructure have been widening over the last 30 years, hampering broad-based income growth.** Public investment reached an average of only 3.2 percent of GDP between 2008 and 2015.[1] Excluding Pemex, the share would be only 1.7 percent of GDP in average over the last years. This falls short of rapidly growing Latin American countries and emerging economies that spend above 5 percent of GDP in this area. Gaps have been widening across sectors, including transport, energy, housing and urban infrastructure, and water.

3. **Water infrastructure is particularly affected by underinvestment with highly negative potential consequences to the welfare of the population and the economy**. More than 35 million Mexicans have limited access to water or receive low-quality water services. More than a hundred of the country's 731 watersheds face severe water shortages, and the number of aquifers overdrafted has tripled between 1975 and 2013.[2] Overall, water availability per capita has reduced drastically, from 18,035 to 3,982 m3/inhabitant per year between 1950 and 2013.[3]

4. **Despite the deceleration in economic activity underway since the second quarter of 2018, Mexico maintains a prudent macroeconomic policy framework**. On the demand side, despite real wage growth and strong remittance inflows in 2019, private consumption growth dipped to its slowest pace in the last years. Dragged by wage and other recurrent spending cuts in public administration, government consumption also slowed significantly over the first half of 2019. A degree of uncertainty around the trajectory of some of the new administration's sectoral policies, slowed investment further, which had been weak since 2016. In this context, inflation pressures continue to subside even with the significant minimum wage increase enacted at the beginning of 2019. The policy rate has helped the local currency to hover below 20 pesos per dollar, as Mexico remains attractive to portfolio investors, but with less positive effects for fixed capital formation. Fiscal consolidation

[1] Infralatam (Economic Infrastructure Investment Data, Latin America and the Caribbean) (database), Economic Commission for Latin America and the Caribbean, the Development Bank of Latin America, and the Inter-American Development Bank, Washington, DC, *http://infralatam.info/*.
[2] The number of overdrafted aquifers increased from 32 in 1975 to 126 in 2013, out of a total of 653.
[3] National Water Plan 2013-2018, CONAGUA.

enabled the achievement of public debt stabilization. Mexico led emerging markets in stabilizing and then reducing public debt as a share of GDP, which stood at 53.6 percent in 2018 for gross public-sector debt (44.9 percent on a net basis as reported by the government). Expenditure rationalization measures plus the use of its revenue stabilization fund broadly enable the authorities to compensate for lower than expected revenue collection during 2019. Adherence to fiscal prudence is expected to continue as the administration presented its 2020 budget with a primary surplus and an overall fiscal deficit in line with the objective of stabilizing the public debt-to-GDP ratio. The budget emphasizes categorical social programs (minimum pension, student grants and stipends for youth) and a moderate public investment increase, which are financed by program consolidation and cuts in public wages, goods and services, and discretionary transfers to states.

B. Sectoral and Institutional Context

5. **Water stress[4] is a critical vulnerability for Mexico, including in the context of climate change.** As the country's population has grown, water availability per capita has fallen sharply, dropping from 18,035 cubic meter (m^3) per year in 1950 to 3,392 m^3 per year in 2015. The National Water Commission (CONAGUA for its Spanish acronym - *Comisión Nacional del Agua*) projects that water resources per capita will fall to 3,250 m^3 by 2030.[5] Moreover, rising global temperatures and shifting precipitation patterns are already affecting the country's hydrological cycles, and the increasing strain on the country's scarce water resources is leading to the overexploitation of groundwater and productivity losses. Groundwater provides more than 65 percent of all water used by Mexican cities. Pumping in excess of natural recharge causes land subsidence (or sinking), which makes flooding worse and causes significant structural damages to urban infrastructures. For example, subsidence levels in Mexico City are up to 43 centimeters (cm) per year[6]. The economic costs of water depletion and degradation have increased over the last 15 years.

6. **The water sector would require significant, innovative and complex investments, together with increased institutional capacity, to sustainably provide water to the population**. In addition to the existing water service access gaps[7], limited investment in key water management infrastructure is exposing Mexico to higher climate and non-climatic related risks while increasing opportunity costs of underinvestment. Mexico has a large network of dams with 150km^3 stored in 667 facilities. However, many of them were built more than 50 years ago, and increased investment in maintenance and rehabilitation is pressing to ensure their continued operation, protect local populations from potential dam failures, improve energy efficiency of hydropower generation, and provide a more reliable service to the population. Moreover, tightening fiscal space is constraining investment. The authorities are open to public-private investments in the sector, particularly downstream. An ambitious program to strengthen the planning, funding and implementation functions is critical to enhance the delivery capacity of the water system and infrastructure in the country.

7. **The Valley of Mexico region has one of the highest water stress levels of the country**. This area of the country generates an estimated 38 percent of Mexico's GDP (including the Valley of México Metropolitan Area - VMMA and Toluca Metropolitan Area -TMA). Together**,** these two metropolitan areas account for a population

[4] Water stress is calculated by comparing the percentage of water allocated to the amount of renewable water. The Valley of Mexico has the highest water stress index (140 percent) in Mexico, signifying that it uses 40 percent more water than annual renewable resources.
[5] CONAGUA, 2016. "Numeragua Mexico." Secretaría de Medio Ambiente y Recursos Naturales and Comisión Nacional del Agua.
[6] Solano-Rojas, et al. *La relación de subsidencia del terreno InSAR-GPS y el abatimiento del nivel estático en pozos de la zona Metropolitana de la Ciudad de México*; Boletín de la Sociedad Geológica Mexicana; 2015.
[7] More than 35 million Mexicans have limited access to water or receive low-quality water services.

of almost 23.4 million people and host a diverse range of economic activities, from manufacturing to agricultural farmland, that require water for both consumption and economic development. Nevertheless, deficient water services, compounded by unreliable bulk water supply, impose economic costs on households and firms equivalent to an estimated 1 percent of the GDP of the VMMA.[8] With an estimated population of 21.5 million, the VMMA is considered the most populated urban center in Latin America, and currently demands a mean water supply of 63 cubic meters per second (m^3/s)[9] for human consumption and industrial and commercial needs and an estimated supply of 11 m^3/s for irrigation purpose. The TMA houses a population of approximately 1.9 million people with a mean water demand of 4.7 m^3/s.[10]

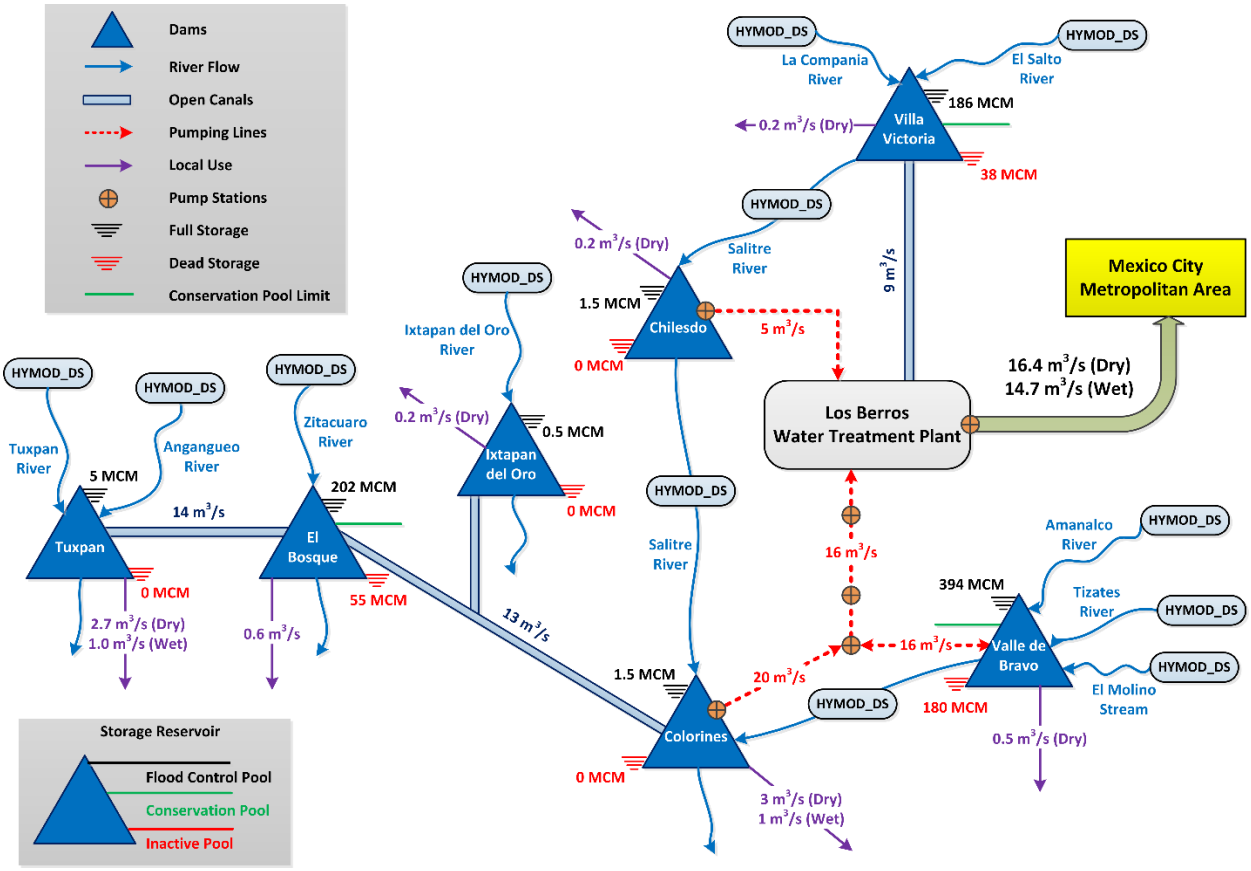
8. **The bulk water supply and water service provision for these two areas constitute a major challenge for the country.** Urban water demands for the VMMA are currently being met through three principal sources: groundwater from the main aquifer below the Valley of Mexico, which accounts for approximately 68 percent of the total supply; and two water transfer schemes, the Cutzamala System (24 percent) and the Lerma System (8 percent). Water demands for the TMA are being met through groundwater (84.6 percent) and the Cutzamala System (15.4 percent). CONAGUA is in charge of the planning, operation, financing, and delivery of these key water systems and sources. Downstream water and sewage service provision in Mexico City is the responsibility of the Mexico City Water Utility (SACMEX for its Spanish acronym - *Sistema de Aguas de la Ciudad de México*), which faces challenges including intermittent service provision for a quarter of customers and high leakage. Both CONAGUA and SACMEX have prioritized water security of the Valley of Mexico through a series of actions, namely: (i) increase in reliability and supply of water; (ii) improvement in the efficiency, sustainability, and institutional management of the Cutzamala System; (iii) reduction in the rate of subsidence of land due to over-abstraction of the aquifer; (iv) reduction in leakages; (v) improvement in the management and service of the Cutzamala System; and (vi) improved governance of SACMEX.

The Cutzamala System

9. **The Cutzamala System plays an essential role in the supply of water for the VMMA and TMA.** This integrated water system – one of the country's largest engineering works – was originally designed in 1930 for hydropower generation and then from the late 1960s to 1993 transformed into an inter-basin water transfer system to reduce VMMA and TMA's dependence on groundwater resources. The Cutzamala System sources water from a multitude of rivers and springs from six sub-basins[11] in the States of Mexico and Michoacán. For this, the system uses eight main reservoirs, six main pumping plants, 322 kilometers (km) of canals (none of which are navigable) and tunnels, and the large Los Berros potable water treatment plant located outside Mexico City (Map 2 in Annex 5 and Figure 1). The Cutzamala System provides an average of 15 m^3/s to VMMA and TMA and is essential to maintain water pressure in the water distribution systems. The reliability of the Cutzamala System – defined in terms of percentage of days in the year that the System supplies the targeted water volume to Mexico City – currently stands at 82 percent[12]. Reasons for not reaching 100 percent reliability include: (i) the lack of timely information on water availability in the basins, (ii) the lack of an automated system for infrastructure management, and (iii) the limited flexibility to operate the System in the event of maintenance works or rapid changes in water levels.

[8] World Bank, 2013, *Agua urbana en el Valle de México – ¿un camino verde para mañana?*
[9] CONAGUA-World Bank, 2015, Cutzamala Integral Diagnostic.
[10] Idém
[11] These basins span upwards of 10,500 km^2.
[12] World Bank Decision Tree report 2017.

Figure 1. Cutzamala System Schematic



10. **Furthermore, many of the Cutzamala System's dams, which date from the mid-1900s, require rehabilitation and safety improvements to address critical dam safety issues.** The Cutzamala System heavily relies on the safe and reliable operation of eight dams. A preliminary joint assessment by CONAGUA and the World Bank has identified several dam safety issues and deficiencies, in both structural and non-structural aspects. The inspections to date have identified no visible anomalies, which could lead to immediate breach of dams operating under normal conditions. These dam safety issues, coupled with the reliability challenges mentioned above, pose serious risks to water security in the Valley of Mexico.

11. **The Cutzamala System is an energy intensive and energy-inefficient system.** During the 30 years of operation of the System, various actions have been carried out to maintain the energy efficiencies of the pumps and other infrastructure. However, operating costs stemming from energy remain extremely high, representing a considerable budgetary burden for CONAGUA. It is important to look for various energy savings alternatives that could include optimization in the use of pumps, optimization of energy use in the potable water treatment facility, use of renewable energy and potential generation of electricity with micro-hydropower, among others.

12. **The VMMA and TMA depend on the Cutzamala System as a main water provider, but also as a buffer for water shocks, including seismic events. Yet climate change, among other factors, puts its reliability at risk.** The September 2017 earthquake resulted in widespread damages to water distribution infrastructure in VMMA, including groundwater wells and the Mixquic-Tláhuac Aqueduct. Flow in the Cutzamala System was increased to

17 m^3/s to compensate for losses from other systems.[13] Nevertheless, a recent study concluded that climate change could negatively impact the reliability of the Cutzamala System by altering precipitation patterns.[14] An ensemble of General Circulation Models (GCMs) concludes that by 2050, temperatures may increase between 1 and 4 degrees Celsius and precipitation changes are estimated in the order of +20 and -40 percent, with many GCMs converging to an average annual precipitation of 978 mm in the six sub-basins, representing a decrease rather than an increase in annual precipitation. This could potentially lead to an increase in the frequency and intensity of droughts. Additionally, during the rainy season the intensity of rainfall may increase with potential cases of additional flooding in the VMMA. The Mexican Institute for Water Technology (IMTA for its Spanish acronym - *Instituto Mexicano de Tecnología del Agua)* estimates that nearly 50 percent of the six sub-basins area has a high to extreme degradation level, which impacts biodiversity and water quality. At the same time, economic and population growth in the VMMA, the TMA, and sub-basins of the System are increasing demands for water. Taken together, these climate and economic factors increase the risks to the System's reliability.

13. **To address these challenges, the Basin Agency for the Valley of Mexico** (OCAVM for its Spanish acronym - *Organismo de Cuenca Aguas del Valle de México*) **led a technical cooperation program in 2013 to establish a framework for an integrated basin management plan for the Cutzamala System and its sub-basins in collaboration with the National Autonomous University of Mexico** (UNAM for its Spanish acronym - *Universidad Nacional Autónoma de México)***, IMTA, and the World Bank.** This effort identified a comprehensive set of institutional actions and investments for the Cutzamala System and its sub-basins. These activities were carried out as a series of Reimbursable Advisory Services (RAS). They produced an integrated assessment of the Cutzamala System and its sub-basins[15] and informed the design of a stakeholder communication platform for the development and implementation of the plan as well as its dissemination to the broader community. These advisory services supported CONAGUA in the development of the Resiliency and Water Security Plan for the Sub-Basins of the Cutzamala, which is arranged around four pillars: (i) existing Cutzamala System infrastructure; (ii) water supply and sanitation services; (iii) irrigation services; and (iv) soil and environmental conservation. The RASs were expanded through a technical assistance in 2017 to apply the World Bank's Decision Tree Framework for Climate Resilience. This last exercise supported CONAGUA to prioritize the interventions under the Resiliency and Water Security Plan incorporating considerations of water security, resilience and reliability.

14. **Multiple federal and local entities are involved in the management of the Cutzamala System.** OCAVM has a mandate to operate and maintain the Cutzamala System infrastructure and is responsible for the delivery of bulk water to the VMMA and TMA. SACMEX receives bulk water transfers from the Cutzamala System and is responsible for water service provision within Mexico City. The Government of Mexico (GoM) recognizes the need to account for this institutional structure in addressing the existing challenges of the Cutzamala System and its sub-basins. Accordingly, the GoM, through CONAGUA, has agreed to support OCAVM to reinforce financial and staff capacity to fulfill its mandate. This situation is particularly critical in the case of OCAVM, which has established a four-year Rehabilitation and Infrastructure Maintenance Program (PROCYMI for its Spanish acronym - *Programa de Conservación y Mantenimiento de la Infraestructura,*) estimated to cost US$1.6 billion to address both operation and maintenance (O&M) and infrastructure improvement needs of the Cutzamala

[13] Joint press conference with the Directors General of CONAGUA and OCAVM; October 5, 2017.
[14] Analysis based on the World Bank's Decision Tree Framework for Climate Resilience, carried out with the support of the Water Partnership Program (WPP).
[15] CONAGUA-World Bank, 2015, Cutzamala Integral Diagnostic.
http://documentos.bancomundial.org/curated/es/309801468189248037/pdf/99219-P150092-SPANISH-WP-PUBLIC-Box393194B.pdf

System (including US$325 million in estimated O&M costs over the four years). OCAVM is working to implement the PROCYMI and other urgent measures to ensure the System's ongoing performance.

15. **To inform and support the operation of dams and other hydraulic infrastructure works for the proper management of water resources, and the operation of the infrastructure for flood management and drought control, the GoM established The National Committee of Large Dams (CNGP for its acronym in Spanish)**. The CNGP, formerly the Technical Committee for the Operation of Hydraulic Works (CTOOH), is a collegiate body with technical functions that was created in 1983. The CNGP is formed by specialists and researchers from different branches of the public sector and academia.

Groundwater Supply

16. **The VMMA relies on the pumping of groundwater from aquifers for human consumption, industrial and commercial use, and irrigated agriculture.** As mentioned above, two-thirds of the drinking water supply in the VMMA is pumped from aquifers across municipal and state boundaries (Map 1). Total groundwater withdrawals for all users (including industrial and agriculture) in the VMMA averages 55 m^3/s. Meanwhile, the increase in urbanization and spread of impermeable surfaces have decreased natural recharge from 31 m^3/s in 1980 to 23 m^3/s in 2015, limiting the natural replenishment of the aquifer. Accounting for inflows from leaks from potable water distribution and irrigation return flow, the result is an estimated net over-exploitation of 23 m^3/s from the VMMA's aquifers.[16] This overexploitation has resulted in the fall of groundwater table under the city of up to 30 meters over the last 20 years, indicating that the current levels of groundwater abstraction are unsustainable.

17. **The ongoing overdraft of groundwater in the VMMA has resulted in significant land subsidence, damaging urban infrastructure and posing challenges to water supply.** As a result of land subsidence, Mexico City is sinking unevenly at up to 43 cm per year.[17] UNAM estimates that land subsidence imposes annual costs of US$1.4 billion in terms of damages to infrastructure, including roads, the metro rail system, and municipal water supply facilities. Finally, as the water table falls, wells that provide water for human consumption must be deepened, increasing energy costs associated with pumping water to the surface.

18. **Institutional and information challenges hinder effective aquifer management.** Multiple entities intervene in the management of groundwater without clear coordination: SACMEX is responsible for the operation of most water supply wells, CONAGUA through its subsidiary OCAVM is responsible for the operation of the 218 wells that make up the Immediate Action Plan (PAI for its Spanish acronym - *Plan de Acción Inmediata),* and a large —but as yet unquantified—number of private users operate groundwater wells. Additionally, the existing aquifer monitoring networks are outdated, and limited information exists on abstraction rates, groundwater level fluctuations and groundwater quality characteristics.

19. **To respond to these challenges, the GoM through CONAGUA has established the Technical Groundwater Management Advisory Committee (COTEMA for its Spanish acronym - *Comité Técnico de Manejo de Aguas Subterráneas*),** comprised of representatives of IMTA, the Federal Electricity Commission, SACMEX, CONAGUA, other public entities, academia, and non-government organizations.

[16] II-UNAM Presentation: "*Plan de gestión integral y manejo de la recarga del acuífero del Valle de México.*"
[17] Solano-Rojas, et al. *La relación de subsidencia del terreno InSAR-GPS y el abatimiento del nivel estático en pozos de la zona Metropolitana de la Ciudad de México*; Boletín de la Sociedad Geológica Mexicana; 2015.

World Bank Support

20. **In 2017, the GoM requested World Bank support for the development of an investment project to support the implementation of the Resiliency and Water Security Plan for the Sub-Basins of the Cutzamala System.**[18] Following the September 2017 earthquake, the GoM renewed its focus on numerous aspects related to seismic risk management and requested additional Bank support for the implementation of the Integrated Plan for Aquifer Recharge and Management in the Valley of Mexico. This five-year investment Project will therefore support the implementation of both plans and is envisioned as the first stage of a 20-year program.

21. **Significant innovations are core to the proposed Project, which can build up important global public goods.** The Project will provide important learning and knowledge value for both the GoM and the Bank, which can later be transferred to other regions and countries. Through this project, a number of innovations can build up important global public goods. They include: i) a complex and integrated project in which, for the first time in a planning process in the water sector, prioritization of activities and investments is done based on the maximization of resilience and robustness metrics; ii) the technological requirements and implementation of groundwater recharge activities with the largest expected recharge volume in any city in the world; and iii) the piloting of new national risk-based dam safety regulations. The lessons learned in the design of this project will enable its replication in other client countries. The vast technical expertise gained through this project will contribute to the generation of an innovative global public good.

C. Higher Level Objectives to which the Project Contributes

22. **The proposed Project is well aligned with the most recent World Bank Group's Country Partnership Framework (CPF) FY20-FY25 for Mexico[19].** In particular, the Project will support the focus area *Enabling Sustainable Infrastructure and Climate Action,* Objective 6 to provide more inclusive and sustainable infrastructure services and Objective 7 to support the GoM achieve its climate change goals, namely by strengthening climate and earthquake resilience, improving energy efficiency in the main bulk water supply system, and supporting the efficient use of surface and groundwater resources for water supply, irrigation and industrial and commercial use for approximately 21.5 million people. This Project is specifically designed to counteract both climate change-related risks (droughts, floods, and shocks to water quality) and earthquake risks. The Project will also contribute to the focus area *Strengthening Institutions for Public Finance, Service Delivery and Economic Inclusion*, in particular its objectives to enhance the management of public resources and to strengthen institutions to deliver high quality, inclusive social services through improved prioritization of investments and institutional strengthening of water resources management (WRM).

23. **The Project likewise contributes to poverty reduction, inclusion, broad-based growth, innovation, and institutional strengthening.** The Project aims to secure water supply for approximately 23.4 million people in the VMMA and the TMA of which approximately 28.4 percent are poor, to improve water pressure in the water supply distribution system in Mexico City and to reduce infrastructure damage losses and coping costs of the falling water table and associated land subsidence for the 21.5 million people in the VMMA. The poorest communities are the ones that suffer the most due to the lack of a reliable service. It also aims to improve an overexploited aquifer and inter-basins transfers through the modernization of its very complex system increasing

[18] The World Bank is the primary international donor active in the WRM space at the national level in Mexico, as well as in water service provision in Mexico City through engagements with SACMEX. Also, in the VMMA, the French Development Agency (AFD) is supporting technical assistance and knowledge exchange on urban drainage.
[19] CPF to be discussed at the Board of Executive Directors on February 27, 2020

the reliability to the provision of water to households and firms in the most critical pole of growth of the country. As stated in paragraph 21, the Project will provide an opportunity to test a number of innovations, such as resilience planning, ground water recharge and dam safety. At the core of the project is to strengthen and build the capacity of CONAGUA, OCAVM, the Water Commission of the State of Mexico (CAEM for its Spanish acronym – *Comisión del Agua del Estado de México*) and SACMEX to effectively manage and operate the Cutzamala system and groundwater resources.

24. **The Project will contribute to the achievement of the United Nations Sustainable Development Goal 6** "Ensure availability and sustainable management of water and sanitation for all" and, in particular, to target 6.5, "Implement integrated WRM at all levels."

II. PROJECT DEVELOPMENT OBJECTIVE

A. PDO

25. The objectives of the Project are to improve the reliability[20] of the Cutzamala System and strengthen the management[21] of groundwater resources in the Valley of Mexico.

B. Project Beneficiaries

26. The Project will yield benefits at two levels. The first level includes an estimated 23.4 million people in the VMMA and the TMA, of which approximately 28.4 percent are poor, who will benefit from improved water security, a reduction in groundwater overdraft, and slowing of land subsidence. The second level of benefits accrue to CONAGUA, OCAVM, CAEM and SACMEX through the strengthening of institutional capacities and improved access to reliable data for groundwater and surface water management.

C. PDO-Level Results Indicators

27. Expected results include:

i. Improved reliability of the Cutzamala System for the delivery of water to the VMMA and the TMA;
ii. Annual reporting on groundwater information (quantity and quality) being used for decision making; and
iii. One managed aquifer recharge pilot operationalized.

D. Results Chain

28. **Attainment of the PDO hinges on the three expected results described in Section C (above).** The first outcome requires the design and implementation of a data collection network, supervisory control, and the establishment of a decision support system. It also requires energy efficiency improvements of the Cutzamala system and the rehabilitation of dams. The second outcome depends on the establishment of an information system for the aquifer. The third outcome relies on the engineering studies and the civil works to rehabilitate existing wastewater treatment plants and related infrastructure to pilot an aquifer recharge project. The results chain, which describes how the project activities in each component are expected to translate into project

[20] Reliability is defined as the percentage of days in which the system successfully supplies the target delivery to Mexico City. This is a widely used metric for the reliability of bulk water systems. Current reliability of the Cutzamala System is estimated at 82 percent (World Bank Decision Tree report 2017).
[21] This includes groundwater monitoring and aquifer recharge.

outputs, intermediate outcomes, project level outcomes, and contribution to the longer-term outcomes/impacts, is presented in Annex 2.

III. PROJECT DESCRIPTION

A. Project Components

29. **Component 1: Improving Energy Efficiency and Resilience of the Cutzamala System (US$60 million, all of which IBRD).** The objectives of this Component are to: (i) strengthen information, monitoring, and control systems for the effective operation of the Cutzamala System; and (ii) improve the safety and reliability of the infrastructure of the Cutzamala System for the delivery of water to the VMMA and the TMA. These activities will support Cutzamala System operators in adapting to changing climate conditions, including droughts and other climate change-induced shocks to water quality and availability, and thus build resilience to climate change by improving data monitoring and collection systems of these risks. The dam-related activities will improve the system's ability to control climate change-induced flooding.

a. ***Sub-component C1.1: Designing, Modernizing and Implementing Infrastructure Information Systems for Resilience of the Cutzamala System.*** This sub-component will finance, inter alia: (a) the improvement of the data collection network to feed a decision support system for the management of water resources in the Cutzamala System basins, including: (i) the rehabilitation of the existing network, (ii) the acquisition and installation of a hydrometeorological and climate network, a water quality monitoring network, a groundwater monitoring network, a network to monitor reservoir and canal levels to measure water distribution and use, and (iii) the acquisition and installation of monitoring equipment for the Cutzamala System Dams; (b) the revision and updating of the existing supervision control and data acquisition system (SCADA) of the Cutzamala System; and (c) the design and implementation of a decision support system to carry out water balances, water allocation, and support the operation of the Cutzamala System.

b. ***Sub- component C1.2: Improving energy efficiency, and reliability of the Cutzamala System infrastructure.*** This sub-component will finance, inter alia: (a) the carrying out of an engineering analysis and design for: (i) an approximately 26 km reversible pressurized transmission line to convey water to the Villa Victoria reservoir, (ii) the rehabilitation works of the Cutzamala System Dams, and (iii) the energy efficiency activities; (b) the development of operation and maintenance plans, and emergency preparedness plans for the Cutzamala System Dams; (c) the carrying out of civil works and the acquisition and installation of electrical and mechanical equipment for the rehabilitation of the Cutzamala System Dams; (d) the implementation of energy efficiency activities; and (e) the supervision of (i) all civil works, and (ii) installation of electrical and mechanical equipment.

30. **Component 2: Groundwater Management and Recharge Pilot infrastructure in the Valley of Mexico (US$54 million, all of which IBRD).** The objectives of this component are: (i) to improve the availability and timeliness of information for groundwater management through an information platform called Aquifer Observatory, and (ii) to support pilot initiatives for managed aquifer recharge. The development of the Aquifer Observatory will provide information for better management of groundwater resources, thus contributing to climate change adaptation. These activities come as a direct response to the September 2017 earthquake and will strengthen resilience to future earthquakes events.

a. ***Subcomponent C2.1: Designing and Implementing an aquifer observatory for the Valley of Mexico.*** This sub-component will finance , inter alia: (a) the collection of baseline data and the carrying out of a diagnostic on water quality and quantity of aquifers, including pumping tests; (b) the preparation of an inventory of wells within the Valley of Mexico, including water user data; (c) the expansion and automation of the piezometric network of the Valley of Mexico; and (d) the improvement of the existing aquifer modeling tool to produce water balances and the dissemination of information.

b. ***Subcomponent C2.2: Carrying out infrastructure works for managed aquifer recharge initiatives in the Valley of Mexico.*** This sub-component will finance, inter alia: (a) the formulation and preparation of engineering analysis and designs; (b) the carrying out of civil works and the acquisition and installation of electrical and mechanical equipment for the upgrading of existing wastewater treatment plants; (c) the construction of aquifer recharge wells; and (d) the construction of conveyance infrastructure from the wastewater treatment plants (WWTPs) to the recharge wells.

31. **Component 3: Institutional Strengthening and Project Management (US$5.7 million, all of which IBRD).** The objective of this component is to strengthen the capacity of the institutions involved in Project implementation and ensure financing of the Project Implementation Unit (PIU). This includes, inter alia, the carrying out of capacity building activities to strengthen water infrastructure operation, groundwater management, citizen engagement mechanisms, including outreach and dissemination activities, and leadership, and technical training for female staff and gender awareness training for CONAGUA's staff.

B. Project Cost and Financing

32. The World Bank will provide a loan of US$120 million, for an Investment Project Financing for five years.

Project Components	Project cost	IBRD Financing
Component 1: Improving Energy Efficiency and Resilience of the Cutzamala System	60.00	60.00
Component 2: Groundwater Management and Recharge Pilot infrastructure in the Valley of Mexico	54.00	54.00
Component 3: Institutional Strengthening and Project Management	5.70	5.70
Total Costs	119.70	119.70
Total Project Costs	119.70	119.70
Front End Fees (0.25%)	0.30	0.30
Total Financing Required	120.00	120.00

C. Lessons Learned and Reflected in the Project Design

33. **Project design has been informed by important lessons learned from Bank financed operations in the water sector in Mexico and best practices from Bank activities on WRM around the world.** Experience from long-running managed aquifer recharge projects in the Mexican State of Aguascalientes and City of San Luis Rio Colorado highlight the importance of assessing the impacts of reclaimed water on the existing aquifer and developing incentives to operate and run the system. The development of water resources information systems under the Project will leverage successful experiences in the region (i.e., Peru and Brazil). The Project will also benefit from the Bank's ample experience in supporting dam rehabilitation and safety in Armenia, Brazil, Indonesia, India, Vietnam, and other countries covering both structural and non-structural measures, as well as in supporting comprehensive risk/hazard assessments for some of the highest dams in the world, such as Nurek Dam in Tajikistan, using Probable Failure Mode Analyses. Based on previous Bank experience with innovative and potentially politically sensitive projects in Mexico, the Project's design includes strong communications and stakeholder engagement campaigns to promote broad understanding and political buy-in to the pilots; and builds in flexibility to make course adjustments, as necessary, should the proposed pilots prove either constitutionally or politically unviable. Learning from past experiences in the implementation of World Bank financed projects in Mexico, Project activities have been carefully sequenced to take into account CONAGUA's budgeting process and reduce delays during Project implementation.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

34. The Project will be implemented by CONAGUA. CONAGUA has longstanding experience in the implementation of World Bank financed projects.[22] The newly created[23] Wellness Bank (BdB for its Spanish acronym- *Banco del Bienestar*), formerly the National Savings and Financial Services Bank (BANSEFI for its Spanish acronym - *Banco del Ahorro Nacional y Servicios Financieros*) will act as the financial agent. BANSEFI has longstanding experience with World Bank financed projects supervising fiduciary aspects, including financial management and procurement.[24] These same capabilities have been transferred to BdB. Additionally, a Technical Advisory Group will be established to inform the implementation of Component 2, Groundwater Management in the Valley of Mexico.

35. The PIU to be established within CONAGUA will be responsible for the coordination of the different activities between the relevant CONAGUA units and other institutions. The PIU will provide technical and administrative support to ensure full development of each Project activity, ensure compliance with the applicable Bank environmental and social safeguard policies, and be responsible for monitoring and evaluation (M&E).

[22] Most recently implemented projects by CONAGUA include: Modernization of the Water and Sanitation Sector Technical Assistance Project, P091695 (PATME – closed in 2008), the Water Utilities Efficiency Improvement Project, P121195 (PROME – closed in 2017) and the Modernization of the National Meteorological Service Project (MOMET – closed in 2016 before completion at the Government's request).

[23] Wellness Bank was created by Decree on July 19th, 2019; *http://dof.gob.mx/nota_detalle.php?codigo=5566165&fecha=19/07/2019*

[24] It should be noted that SACMEX neither is part of the institutional arrangements of the Project nor has a formal role in its implementation.

B. Results Monitoring and Evaluation

36. The PIU will have overall responsibility for monitoring and evaluating progress under the Project based on the results framework presented in Section VII. The PIU will prepare semi-annual progress reports during Project implementation in a manner and format acceptable to the Bank. These reports will describe the overall progress made and the status of all components, activities, environmental and social risk management and, specifically, progress towards achievement of the PDO. The PIU will include an M&E and Planning staff who will report directly to the Project Coordinator.

C. Sustainability

37. The Project builds on three decades of CONAGUA experience operating and maintaining the Cutzamala System. The GoM has demonstrated a clear commitment to the operation and maintenance of the Cutzamala System. This commitment is based on the public good nature and large capital outlays involved in the operation of the more than 300 km of canals, eight dams, and the large Los Berros water treatment plant that make up the integrated system.

38. The Aquifer Observatory will provide a better understanding of the dynamics of groundwater under the VMMA. The flow of data from the Observatory will enable stakeholders to make better decisions for the sustainable management of the region's aquifers. Similarly, the data from the hydrometeorological monitoring system will enable a more efficient operation of the System and delivery of bulk water to Mexico City.

39. Savings on wastewater discharge fees paid by SACMEX (assessed on a volumetric basis for all wastewater discharged to water courses), due to a reduction in the wastewater effluent that is currently discharged into rivers and will be used for aquifer replenishment instead, will be used to cover part of the incremental O&M costs of the recharge pilot projects. The remaining costs will be covered by CONAGUA. In parallel, CONAGUA is assessing financing options for the Integrated Plan for Aquifer Recharge and Management in the Valley of Mexico, including subsidies and the use of the 1928 Trust Fund (*Fideicomiso 1928*). This will contribute to guarantee a sustainable source of finance for the Aquifer Recharge and Management Plan.

V. KEY RISKS

A. Overall Risk Rating and Explanation of Key Risks

40. The overall risk rating for the implementation of the Project is evaluated as **Moderate**. The main implementation risks as per the SORT matrix, together with associated risk management measures, are summarized in the following paragraphs.

a. **Technical Design of Project or Program. Substantial.** Technical risk is rated as substantial as the activities under Component 2 are innovative, relatively new to CONAGUA and require an advanced level of technical skills. Managed aquifer recharge with treated wastewater effluent is an innovative approach to address the challenges of groundwater overdraft and attendant problems, including land subsidence. Although there are a few ongoing examples in Mexico, managed aquifer recharge requires several technical studies and sound technical knowledge. To mitigate this risk, a Technical Advisory Group on groundwater management will be established to provide advice during the implementation of the Project. In addition, the PIU will incorporate qualified staff in the field of managed aquifer recharge.

b. **Environment and Social. Substantial.** The overall safeguards risk is substantial to reflect the substantial environmental risk arising from dam safety aspects. Even if most of the Project works and activities consist of improving existing infrastructure, environment risk is substantial due to dam safety aspects. The Cutzamala System involves the operation of eight dams and there are two Protected Natural Areas (ANP for the Spanish acronym Area Natural Protegida), and several Project activities relate directly to them. The dam safety risk is substantial due to the: (i) presence of populations immediately downstream from several dams in case of extreme climate events that cause flow discharge or overflow; and (ii) reliability of the dams of the Cutzamala System due to deferred maintenance. To mitigate dam safety risks, the Project includes (i) instrumentation of the dams; (ii) civil works, electrical and mechanical equipment for dam rehabilitation; and (iii) development of operational and maintenance and emergency preparedness plans for the dams. An independent panel of experts will review the results from the risk assessments, safety inspections, and operation and maintenance and emergency preparedness plans, as well as advise on the rehabilitation works. To mitigate other environment and social risks, the Project has an Environmental and Social Management Framework (ESMF), and the PIU is deemed to have sufficient technical capacity to comply with the Bank safeguard policies.

VI. APPRAISAL SUMMARY

A. Economic and Financial (if applicable) Analysis

41. The benefits of the Project will not only accrue to individuals, but also to society in terms of improved damn safety, a strengthened capacity for the public sector to manage water resources, and environmental benefits.

42. Energy efficiency measures will result in economic and financial benefits. On the economic side, energy efficiency measures will decrease the negative externalities by improving the efficiency of electromechanical systems, thus reducing the emissions of greenhouse gases, which also contributes to a reduction in air pollution levels. The possibility of generating electricity from renewable sources (i.e. solar) and the water in the canals will reduce the use of electricity from fossil sources. On the financial side, energy efficiency activities will result in significant savings. CONAGUA spends 15 percent of its entire budget for the electricity costs for the Cutzamala system. Financial savings can be used to increase the level of investments in the system to further improve its reliability.

43. Improved ability to meet reliability targets will reduce the amount of groundwater pumped to compensate for shortfalls in Cutzamala System deliveries. It will help to pressurize the VMMA and TMA drinking water networks, thus reducing the infiltration of contaminants and improving water quality for residents.

44. The strengthening and expansion of information and control systems envisioned under sub-components 1.1 and 2.1 are designed to improve and expand existing information systems to provide CONAGUA staff and other stakeholders with the tools they need to make informed decisions and to efficiently manage both groundwater and surface water. The aquifer recharge pilots under sub-component 2.2 will benefit residents, business, and public entities through: (i) the eventual reduction in land subsidence and associated damages; (ii) the in-situ benefits such as reduction in pumping costs and avoidance of the need to replace or deepen production wells; (iii) the improved access to freshwater for human consumption and a source of emergency backup for existing water systems. These pilots will also demonstrate the applicability of managed aquifer

recharge (MAR) technology in the VMMA context to a range of public and private stakeholders. A more thorough treatment of benefits of the proposed activities is available in Annex 4.

Climate Change Aspects

45. The design of the proposed Project responds to a direct need to improve the climate resilience of the Cutzamala system. The activities financed under Component 1 will result in greater system efficiency and improved safety, making it more adaptable to climate change impacts. Moreover, energy efficiency activities financed under Component 1 will improve GHG emissions as described below.

46. The net emissions of the Project are estimated at 208,971 tCO_2-eq over its 30-year economic life, while the gross emissions are estimated to be 769,434 tCO_2-eq. On average, the Project generates estimated net emissions of 6,966 tCO_2-eq annually. For the tertiary treatment and aquifer discharge activities, the estimated net emissions are -112,280 tCO_2-eq for the current level treatment due to switching from grid-connected electricity to biogas, 320,373 tCO_2-eq for electricity use for tertiary treatment, and 0 tCO_2-eq for electricity use for treated wastewater distribution.

47. It should be noted that these net emissions estimates should likely be considered a worst-case scenario due to a lack of data availability for several energy efficiency project activities that will most likely lower the net emissions profile. These include energy efficiency improvements to water supply pumping, the use of pumped storage during the rainy season, and the inclusion of renewable energy sources within existing infrastructure, among other factors. Since the relevant feasibility studies are still being written, the data to perform a GHG accounting analysis for these activities were not available. If these factors were able to be taken into account in this analysis, the net emissions would likely be lower.

Public Sector Rationale

48. Public sector financing is especially relevant in WRM, where a public good is shared among different users and the regulatory power of the State is key to avoid negative externalities. In particular, public sector financing is justified to ensure safety and reliability of infrastructure (i.e. dams and conveyance infrastructure). Additionally, project financed activities will complement and improve discrete and dispersed elements across existing Government infrastructure (i.e., information systems, water conveyance, and wastewater treatment plants for aquifer recharge). The investments in the Cutzamala System form a small portion of a larger system (over 300 km of conveyance infrastructure, eight dams, and a large water treatment plant) that are owned and operated by CONAGUA. Water quality and quantity delivered by the Cutzamala system are directly related to: (i) hydrological conditions in the basin, (ii) water usages for agriculture and drinking water, (iii) waste water discharges currently unregulated and (iv) land use coverage that impacts sediment load. Most of these variables are currently unknown and translate into important risks for private participation that would ultimately result into less favorable contractual arrangements. As a result of this situation private sector involvement is not seen as feasible at this time. Nevertheless, activities financed under Component 1 will provide valuable information to better quantify these risks in case the Government decides to promote a PPP scheme at a later stage. Moreover, aquifer recharge pilots would contribute to reduce soil consolidation, improving soil dynamics in the event of an earthquake, protecting citizens and urban infrastructure. Investments in aquifer recharge pilots will help demonstrate the potential benefits of the available technologies to use treated wastewater to recharge groundwater.

49. There is compelling rationale for the public sector financing of the various activities envisioned under the Project. Additionally, from the technical standpoint, this section cannot be unbundled to be operated independent of the full Cutzamala System. Thus, private sector involvement is not seen as attractive at this time. Throughout implementation, potential entry points for private participation in the broader Cutzamala System can be assessed, though these are unforeseen at this stage.

B. Technical

50. The Resiliency and Water Security Plan for the Sub-Basins of the Cutzamala System is based on a sound technical diagnostic carried out with the Bank's assistance including stakeholder involvement, and technical inputs from IMTA, UNAM and other research institutions. The diagnostic followed a multidisciplinary approach including an evaluation of: (i) the hydrology, water uses and water balances of the basin; (ii) the challenges of the existing infrastructure including eight reservoir dams and pumping/conveyance systems; (iii) water quality aspects; (iv) water service provision in the basin (i.e., water supply and sanitation and irrigation); (iv) environmental issues in the basin; (v) social aspects; and (vi) institutional arrangements.

51. The above mentioned Plan included several infrastructure improvement measures that were thoroughly modeled and prioritized using the Decision Tree framework, which provides a scientifically rigorous approach to support WRM planning under climate uncertainty.[25] Dam safety inspections were conducted and concluded that the Villa Victoria Dam and other reservoir dams need to be rehabilitated and upgraded in order to ensure their safety and reliability.

52. Aquifer recharge pilot sites are the result of years of research from the Engineering Institute at UNAM and IMTA. The study of the aquifer by these two research institutions provided a general model for the aquifer of the Valley of México and identified groundwater recharge options, so successful pilot interventions can be scaled up.

53. The potential technologies under consideration for aquifer recharge pilots include approaches that have proven successful elsewhere in Mexico and abroad. These include the use of injection wells to recharge groundwater, and consideration of advanced wastewater treatment modules such as reverse osmosis, chemical treatment to remove phosphorous, and ultraviolet for disinfection. Specific technologies will be selected based on the water quality characteristics of each site and effluent quality from the existing WWTPs.

C. Financial Management

54. The financial management (FM) risk for this Project is deemed Moderate. Although the Project's technical design is complex, given the high technical capacity required for some of the innovative approaches and activities to be financed, the implementing entity (CONAGUA) has ample experience in implementing Bank financed Projects and has proven capacity in administrative and financial management. Overall FM systems in place and used by the implementing entity are deemed adequate to provide reasonable assurance on the proper use of Project (Bank financed) proceeds. Project transactions and budget control will be incorporated and managed through the accounting and budgetary institutional systems in place, and adequate internal control and external auditing arrangements will also be applied for the Project. Moreover, the PIU will comprise staff with the necessary technical and fiduciary (FM and procurement) capacity to support implementation, in terms

[25] See *Confronting Climate Uncertainty in Water Resources Planning and Project Design: The Decision Tree Framework*; World Bank; 2015; *https://openknowledge.worldbank.org/handle/10986/22544*. A case study applying the Decision Tree framework to the Cutzamala System was completed in 2017, report forthcoming.

acceptable to the Bank. A financial agent (BdB) will also be appointed for this Project by the Ministry of Finances and Public Credit (SHCP for its Spanish acronym – *Secretaría de Hacienda y Crédito Público*) to provide fiduciary and overall implementation support and oversight. In sum, although technical complexity will require close oversight and extensive support from the Project's Task Team, it is not considered to have a substantial impact on the FM risk assessment. FM systems and arrangements that will be used for the Project are considered adequate to provide reasonable assurances to the proper use of Project (Bank financed) funds for intended purposes. Therefore, the residual FM risk for this Project is deemed Moderate.

D. Procurement

55. Procurement for the Project will be carried out by CONAGUA. The Project will be executed in accordance with the World Bank's Procurement Regulations for IPF Borrowers – July 2016 and revised November 2017 ("Procurement Regulations"). CONAGUA will be responsible for all procurement and contracting related queries and processing of the Project, including management and compliance with fiduciary requirements. CONAGUA has previous experience implementing procurement following the Bank's Procurement Guidelines in multiple projects.

56. A Project Procurement Strategy for Development (PPSD) was prepared and identified the appropriate selection methods and market approach.

57. **Procurement Plan.** CONAGUA has prepared an acceptable Procurement Plan to be filed and updated in STEP (World Bank's Systematic Tracking of Exchanges in Procurement System). Most of the Project activities will be carried out through Request for Bids, regarding the purchase of Civil Works, Goods and Non-Consultants Services. For Consulting Services, the processes will be carried out under the following selection methods: Quality and Cost Based Selection (QCBS), Quality-Based Selection (QBS), Selection under a Fixed Budget (SFB), Least- Cost Selection (LCS), and Selection Based on Consultants' Qualifications (CQS) for contracting Firms and comparing curriculum vitae for Individual consultancy.

58. **Overall Risk Assessment.** Procurement activities to be carried out for this Project are complex, but the proposed Procurement arrangements, the preparation of the PPSD, the Procurement knowledge of *Banco del Bienestar* as Financial Agent, and the prior-post review arrangements all contribute to the **Moderate** risk rating for procurement. Mitigation actions are described in Annex 2.

E. Social (including Safeguards)

59. The social safeguards risk of the Project is classified as "Moderate," as the Project is not expected to have negative social impacts on Indigenous Peoples (IP) or other stakeholders, and the Project alleviates risks of water shortages and social disruptions. Both OP 4.10 (Indigenous Peoples) and OP 4.12 (Involuntary Resettlement) are triggered and described in further detail below.

60. Indigenous Peoples (OP/BP 4.10). CONAGUA prepared a Social Assessment (SA) to identify positive and/or negative social impacts and establish appropriate mitigation measures if deemed necessary. The SA indicates the presence of IP, namely the Mazahua, in the Project area (Valley of Mexico), and also identifies that Project impacts will be rather positive. CONAGUA prepared, consulted and disclosed an IPPF that provides guidance for preparing of IPPs where necessary, when potential positive or adverse effects on IP are identified in the adjacent communities. The IPPF was deemed satisfactory and disclosed by the Borrower and the Bank.

61. Involuntary Resettlement (OP/BP 4.12). The Project is not expected to result in involuntary land acquisition, resettlement, and/or displacement of people irrespective of whether they are indigenous or non-indigenous. Pilot projects under Component 2.2 will be carried out on government-owned lands. However, OP 4.12 is triggered as a precautionary measure, for the unlikely case that land acquisition or resettlement will be needed. The Resettlement Policy Framework (RPF), which was prepared, consulted and disclosed by CONAGUA, and deemed satisfactory and disclosed by the Bank, establishes the guide for the preparation of specific Resettlement Action Plans (RAP) in cases where involuntary resettlement is needed.

62. The safeguards instruments that describe the Project-related environmental and social risks, impacts and the applicable mitigation measures have been assessed and consulted with stakeholders. Two public consultation meetings were held: (i) a public meeting in the basin of Mexico on December 8, 2017, and (ii) a public meeting in the Cutzamala sub-basin, on December 7, 2017. Local authorities, service providers, representatives of different service users and other stakeholders, including IP, attended the consultations, ensuring full participation.

63. Feedback received from the consultations was summarized and incorporated in each safeguard instrument as appropriate. Feedback from the stakeholders, including the Mazahuas, focused on the request to the GoM to: (i) strengthen citizen participation mechanisms and mainstream communication and outreach efforts to indigenous communities; (ii) allocate the equivalent of 5 percent of the total cost of works and infrastructure for the implementation of infrastructure and community services; and (iii) ensure the continuation of the integrated basin management. The ESMF, IPPF and RPF were initially updated and disclosed by CONAGUA and the Bank on their respective external websites on January 15, 2018. The instruments were updated to reflect the reduced scope of the Project investments after confirming the final loan amount of US$ 120 million at the end of 2019. The updated ESMF, IPPF and RPF were re-disclosed by CONAGUA and the Bank on their external websites on December 17, 2019 and December 18, 2019 respectively.

64. **Gender.** The Project aims to close the gender gaps in the water sector in CONAGUA and further contribute to capacity building for the operation by focusing on women working in the institutions involved in Project implementation. Although CONAGUA has put in place a series of policies and regulations to foster a gender-friendly work environment, significant differences in professional opportunities persist between women and men. CONAGAUA meets international standards in gender representation in the workplace, with 35 percent of all employees being women. However, the representation of women drops significantly in managerial positions, where women make up only 14 percent of senior management roles. Nearly 97 percent of female employees work in the lowest grade. During project preparation, female employees of CONAGUA reported that working conditions, particularly promotions, favor men and that female employees do not have equal opportunities for professional growth. Being a strongly male-dominated work environment with a masculine work culture, many female employees, particularly those working in technical areas, reported feeling isolated and lacking confidence. Evidence for the inequality in employment opportunities is found in Mexico's forthcoming CPF, which shows that around 46 percent of women are economically active in the labor force and that there is persistent occupational segregation, with women working longer hours than men. The LAC Regional Gender Action Plan[26] similarly shows that, throughout the LAC region, women are typically engaged in lower quality economic opportunities, in large part due to social norms that assign women to domestic tasks.

65. A gender needs assessment conducted during Project preparation found that providing a leadership and technical training for female staff to build the technical capacity and leadership skills of women in CONAGUA (to

[26] World Bank. 2018. Closing Gender Gaps in Latin America and the Caribbean. Washington, D.C.: The World Bank.

be financed under Component 3) would contribute to closing the gender gaps they face in their work environment. In addition, a gender awareness training for CONAGUA's staff will help to balance female professionals largely underrepresented and sidelined in a male-dominated environment. It is expected that this training program will both enhance their opportunities for professional growth within the institution, and also bolster their voice and leadership. The Project will undertake a capacity and skills needs assessment of female employees of CONAGUA, including an assessment of the requirements for potential career growth, to develop a tailored program aimed to equip women for career enhancement.

66. To monitor the success of the gender training program, the Project has included an intermediate results indicator to measure the extent to which female employees feel satisfied that the training sufficiently and adequately helped them gain technical and leadership skills. At Mid-Term Review, a survey will be conducted, the results of which will be used to modify and improve the training program; at Project Closing, a survey will assess the outcomes of the activity and whether female employees of CONAGUA feel that the skills obtained meet their expectations for strengthening their career opportunities.

67. **Citizen Engagement.** CONAGUA has mechanisms for beneficiaries and stakeholders to provide feedback. An online information platform and a Grievance Redress Mechanism (GRM) hotline are available for citizens to register complaints or satisfaction with services by/related to CONAGUA. As part of the institutional strengthening component, the Project will support CONAGUA to boost awareness of the existence of these grievance-handling procedures among the public and to enhance the mechanisms with which grievances are redressed as they relate to the Project. To this end, a communication campaign will be carried out before and during the implementation of the Project, with the aim of spreading information on the existence of the online information platform and the hotline to communities affected by the Project. This campaign will entail putting up posters with the telephone numbers of the hotline in public spaces. Additionally, to facilitate the communication between Project implementers and possible citizens with complaints, CONAGUA personnel will be designated to receive complaints in situ. The Project will also support CONAGUA in developing and implementing a mechanism with which to respond to complaints in a timely manner. This will involve a specific protocol enabling the prompt conveying of grievances received through the online platform and the hotline to the corresponding person in charge. In this manner, the Project will promote a meaningful two-way interaction between citizens of the area and the Project implementing entities. A beneficiary feedback indicator has been included in the Project results framework to measure whether grievances registered related to the delivery of Project benefits are addressed.

F. Environment (including Safeguards)

68. The Project activates OP 4.01 on Environmental Assessment and is classified as an Environmental Category B operation. Its environmental risk is rated Substantial due to the type of the civil works envisioned under Components 1 and 2 and the related dam safety risks. The expected negative environmental impacts, however, are relatively limited in scope and magnitude, and CONAGUA has successful experience in the implementation of the associated mitigation measures. The referred impacts are associated with activities and works to be carried out in areas where water abstraction, storage (dams), and conveyance infrastructure already exist and within selected pilot sites for recharging the main aquifer below the Valley of Mexico with treated wastewater.

69. The Project includes works and activities for which the corresponding detailed designs and thus the sites construction procedures and technologies are yet to be defined. Consequently, CONAGUA has developed, consulted and disclosed an ESMF, which has been deemed satisfactory and disclosed at the World Bank external

website. The ESMF includes the necessary screening procedures to identify, evaluate and manage the possible environmental risks and impacts. It identifies the environmental requirements that must be met by the contractors and will be included in the bidding documents and contracts. The bidding documents and contracts will require compliance with the applicable Mexican laws and regulations, World Bank safeguard policies and implementation of standard good environmental practices. The ESMF covers: (i) screening of potential works for environmental risks and impacts; (ii) carrying out a required environmental assessment to obtain regulatory authorization for each work as applicable; and (iii) implementing necessary mitigation and monitoring measures. It also includes institutional capacity, training, supervision, monitoring and reports applicable to CONAGUA.

70. The Project activates OP 4.04 on Natural Habitats, since there are two Protected Natural Areas (ANPs) in the area of influence of the Cutzamala System and some of its existing infrastructure and part of the Project works are in the ANPs. Both the Monarch Butterfly Biosphere Reserve and Valle de Bravo, Malacatepec, Tilostoc and the Temascaltepec River Basins Protected Natural Resources Area are of federal responsibility and present serious contamination and deterioration of natural habitats derived from unplanned anthropogenic activities that have been carried out for years on the sites. It is foreseen that the works related to the rehabilitation of the water storage, treatment and conduction and energy efficiency infrastructure of the Cutzamala System, to be carried out within the Monarch Butterfly Biosphere Reserve and in its vicinity, will not contribute to further deteriorating the ANP beyond temporal impacts due to construction activities, given they will be carried out mainly on the footprint of the existing infrastructure without need to occupy new land. The ESMF establishes appropriate criteria to ensure that impacts on natural and critical habitats are adequately addressed. The ESMF also excludes works that could involve significant conversion of natural or critical habitats from Project financing.

71. The Project activates OP 4.11 on Physical Cultural Resources, as there is some potential for chance finds during works that involve excavations. No significant impacts are expected on known physical cultural resources. The ESMF includes the necessary chance find procedures to address possible findings of archaeological or other cultural resources during the construction of any Project works.

72. The Project activates OP 4.37 on Safety of Dams as it will support CONAGUA's ongoing dam safety efforts, through the following activities for the Cutzamala System Dams: (i) instrumentation of the dams (under Sub-component 1.1); (ii) civil works, electrical and mechanical equipment for the dam rehabilitation (under Sub-Component 1.2); and (iii) the development of operational and maintenance plans and emergency preparedness plans for the dams (under Sub-Component 1.2). Additionally, an independent panel of experts will be established and will have the following responsibilities: (i) reviewing the risk-based dam safety assessments, safety inspection reports, operations and maintenance plans and emergency preparedness plans for all for the Cutzamala System dams; (ii) advising on the design and implementation of rehabilitation works required for the Cutzamala System dams; and (iii) reviewing the investigation, design and implementation of high-hazard cases involving significant and complex remedial works.

73. Panel of Experts: The Borrower, CONAGUA and the Bank discussed and agreed that CONAGUA will propose and the Bank will evaluate the inclusion of independent members of the National Committee of Large Dams (that are not officials of CONAGUA) for them to conform the Panel of Experts required to be established pursuant to Section I.D.3 of Schedule 2 to the Loan Agreement.

74. The Borrower, CONAGUA and the Bank further discussed that said Panel of Experts shall be established at the earliest time. As the Project also includes activities that don't rely on said dams, in case of doubt prior to the implementation of a Project activity that might rely on the Cutzamala System Dam, and in case the Panel of

Experts has not been established at that point, CONAGUA will consult the Bank and the Bank will confirm whether that activity relies or not on the Cutzamala System Dam.

75. To date, CONAGUA has established national dam safety standards within the framework of the National Water Law and the Federal Law on Metrology and Standardization and its Regulations. The two main norms regarding dam safety operation were published in the Official Journal of the Federation in 2015: NMX-AA-175-SCFI-2015: Safe Dam Operation – Part 1 – Risk Analysis and Classification of Dams and in 2016: NMX-AA-175-SCFI-2015: Safe Dam Operation – Part 2 – Safety Inspections. A third norm, establishing the requirements for the preparation and implementation of an Emergency Action Plan for each dam, was published in 2018: NMX-AA-175/3-SCFI-2017: Safe Dam Operation – Part 3 – Emergency Action Plan.

76. CONAGUA has gradually started to roll out these new norms and very few dams have been assessed using the referred technical procedures. CONAGUA has agreed to prioritize the assessment and rehabilitation/safety improvement of the Cutzamala System dams as pilots to follow these recent regulations, considering that these dams are considered national priority infrastructure for ensuring safe and reliable water supply to the VMMA. CONAGUA will conclude the assessment of the Cutzamala System dams following the 2015 regulations mentioned above during the first two years of Project implementation. The experience gained through the Project´s support for compliance with the 2015 regulations will enable CONAGUA to better comply with the dam safety procedures across the country.

77. **Evaluation of environmental and social management capacity.** CONAGUA has the necessary capacity and experience to implement the aforementioned social and environmental safeguards. The supervision of the works will cover evaluation of the contractors' compliance with environmental, social, health and safety (ESHS) as well as cultural requirements. CONAGUA and the assigned contractors will be responsible for the ESHS management of the Project works. Strong environmental clauses will be included in the terms of reference and contracts to indicate the obligation of the participating contractors to have the necessary management capacity related to ESHS aspects.

G. Other Safeguard Policies

77. No other safeguard policies are triggered for the Project.

H. World Bank Grievance Redress

ıunities and individuals who believe that they are adversely affected by a World Bank (WB) supported Project may it complaints to existing Project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The nsures that complaints received are promptly reviewed in order to address Project-related concerns. Project affected ıunities and individuals may submit their complaint to the WB's independent Inspection Panel which determines ıer harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may ɔmitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management een given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate ance Redress Service (GRS), please visit http://www.worldbank.org/en/projects-operations/products-and-es/grievance-redress-service. For information on how to submit complaints to the World Bank Inspection Panel, please ww.inspectionpanel.org.

VII. RESULTS FRAMEWORK AND MONITORING

Results Framework
COUNTRY: Mexico
Water Security and Resilience for the Valley of Mexico (PROSEGHIR)

Project Development Objective(s)

The objectives of the Project are to improve the reliability of the Cutzamala System and strengthen the management of groundwater resources in the Valley of Mexico

Project Development Objective Indicators

Indicator Name	DLI	Baseline	End Target
To improve the reliability of the Cutzamala System			
Improved reliability of the Cutzamala System for the delivery of water to the VMMA and the TMA (Percentage)		82.00	90.00
To strengthen the management of groundwater resources in the Valley of Mexico			
Annual reporting on groundwater information (quantity and quality) being used for decision making (Yes/No)		No	Yes
One managed aquifer recharge pilot operationalized (Number)		0.00	1.00

Intermediate Results Indicators by Components

Indicator Name	DLI	Baseline	End Target
Component 1: Improving Energy Efficiency and Resilience of the Cutzamala System			
SCADA system in place and using data from monitoring network. (Yes/No)		No	Yes
Dam operation and maintenance and emergency plan prepared and adopted by CONAGUA (Number)		0.00	8.00
Dams rehabilitated under the Project. (Number)		0.00	4.00
Engineering analysis and design of the pressurized transmission line (Yes/No)		No	Yes
Improved dam safety in key Cutzamala dams (Number)		0.00	1.00
Component 2: Groundwater Management in the Valley of Mexico			
Water balance updated for the Valley of Mexico. (Yes/No)		No	Yes
Aquifer model improved to include monthly variability. (Yes/No)		No	Yes
Construction of advanced wastewater treatment facilities to meet effluent standards for aquifer recharge. (Number)		0.00	1.00
Engineering analysis and designs completed for advanced waste water treatment facilities (Yes/No)		No	Yes
Component 3: Institutional Strengthening and Project Management			
Grievances resolved related to delivery of project benefits addressed (Percentage)		0.00	95.00
Number of CONAGUA employees (female) who have completed training. (Number)		0.00	300.00
Percentage of women expressing satisfaction with the technical and leadership training. (Percentage)		0.00	80.00

Monitoring & Evaluation Plan: PDO Indicators					
Indicator Name	**Definition/Description**	**Frequency**	**Datasource**	**Methodology for Data Collection**	**Responsibility for Data Collection**
Improved reliability of the Cutzamala System for the delivery of water to the VMMA and the TMA	Reliability is defined as the percentage of days in which the system successfully supplies the target delivery to Mexico City. This is a widely used metric for the reliability of bulk water systems. Current reliability of the Cutzamala System is estimated at 82 percent (World Bank Decision Tree report 2017).	Annual	Reports	OCAVM records the amount of water delivered to Mexico City and State of Mexico and the reliability is defined as the percentage of days in which the system successfully supplies the target deliveries of water supply.	PIU
Annual reporting on groundwater information (quantity and quality) being used for decision making	This indicator reflects the improvement in the monitoring aspects of groundwater management in the VMMA.	Annual	Reports	Data from physical monitoring in situ is captured and analyzed and presented in the reports from the specialized firm to the client.	PIU
One managed aquifer recharge pilot operationalized	This indicator captures the engineering analysis and construction of one	Annual	Reports	Technical specifications in terms of reference for engineering studies will	PIU

	managed aquifer recharge pilot in the VMMA.			define the methodological approach to follow.	

Monitoring & Evaluation Plan: Intermediate Results Indicators					
Indicator Name	**Definition/Description**	**Frequency**	**Datasource**	**Methodology for Data Collection**	**Responsibility for Data Collection**
SCADA system in place and using data from monitoring network.	This indicator captures the development and implementation of the updated Supervisory Control and Data Acquisition network for the Cutzamala System.	Annual	Reports	No data collection expected in this activity. This is for the implementation of the SCADA system so the system will be installed and put in operation	PIU
Dam operation and maintenance and emergency plan prepared and adopted by CONAGUA	This indicator captures progress made under the Project on dam safety through the preparation and adoption of (i) operation and maintenance and (ii) emergency plans for the Villa Victoria, Chilesdo, Colorines, Valle de Bravo, El Bosque, Ixtapan del Oro, Tuxpan, and Tilostoc dams.	Annual	Reports	Terms of reference for the formulation of the Plan will depict data requirements and data gathering methods.	PIU
Dams rehabilitated under the Project.	This indicator measures progress made under the	Annual	Reports	No data collection expected as this activity	PIU

	Project on the rehabilitation of the Villa Victoria, Chilesdo, Colorines, Valle de Bravo, El Bosque, Ixtapan del Oro, Tuxpan, and Tilostoc dams.			is to implement civil works and maintenance for the rehabilitation of dams.	
Engineering analysis and design of the pressurized transmission line	This indicator captures progress on the preparation of the engineering analysis and designs of the Villa Victoria pressurized transmission line.	Annual	Reports	Technical specifications in terms of reference will identify the data needs for the formulation of the engineering studies	PIU
Improved dam safety in key Cutzamala dams	This indicator captures the number of dams rehabilitated following international dam safety standards	Annual	Reports	International dam safety standards will be used. These standards have a defined methodology for data collection.	PIU
Water balance updated for the Valley of Mexico.	This indicator captures the development of an updated water balance to measure water in- and outflows from the VMMA.	Annual	Reports	Methodology for the development of a water balance are established and is the one to be implemented.	PIU
Aquifer model improved to include monthly variability.	This indicator captures the updating of the existing aquifer model to incorporate monthly variability.	Annual	Reports	This activity supports the incorporation of monthly variability to the existing aquifer model. Methodology is well established and will	PIU

				be described in the terms of reference.	
Construction of advanced wastewater treatment facilities to meet effluent standards for aquifer recharge.	This indicator captures progress on the upgrading of existing wastewater treatment facilities to meet prevailing standards for aquifer recharge using treated wastewater effluent.	Annual	Reports	Technical specifications in terms of reference use engineering design standards	PIU
Engineering analysis and designs completed for advanced waste water treatment facilities	This indicator captures progress on the preparation of the engineering analysis and designs for the upgrading of existing wastewater treatment facilities to meet prevailing standards for aquifer recharge using treated wastewater effluent.	Annual	Reports	Engineering design standard methodology	PIU
Grievances resolved related to delivery of project benefits addressed	This indicator measures the number of resolved grievances over the number of registered grievances (in percentage).	Annual	Reports	Data for grievances used CONAGUA's methodology	PIU
Number of CONAGUA employees (female) who have completed training.	This indicator measures the number of female employees of CONAGUA who have received dedicated technical and	Annual	Reports	Number of participants per learning event.	PIU

	leadership training under the Project.				
Percentage of women expressing satisfaction with the technical and leadership training.	This indicator is designed to capture the results of the technical and leadership training provided under the Project to female employees at CONAGUA. An ex post survey will be administer to training participants to understand their level of satisfaction with the training. The satisfaction will be measured through a compound scoring system to measure increased opportunities for career enhancement.	Annual	Reports	Surveys after the leadership training events.	PIU

ANNEX 1: DETAILED PROJECT DESCRIPTION

COUNTRY: Mexico
Water Security and Resilience for the Valley of Mexico (PROSEGHIR)

1. **Project Description.** The Water Security and Resilience for the Valley of Mexico Project responds to requests from the GoM to support the operationalization of its Resiliency and Water Security Plan for the Sub-Basins of the Cutzamala and its Integrated Plan for Aquifer Recharge and Management in the VMMA. The Project design envisions key structural measures for bulk water supply, dam rehabilitation, energy efficiency, and aquifer recharge, coupled with the strengthening of information, monitoring, and control systems that will serve as tools for the effective management of ground and surface water. The Project is structured in three components: (i) Improving Energy Efficiency and Resilience of the Cutzamala System; (ii) Groundwater Management and Recharge Pilot Infrastructure in the Valley of Mexico; and (iii) Institutional Strengthening and Project Management. The lending instrument will be an Investment Project Financing (IPF) of US$120 million to the United Mexican States with an implementation period of five years.

Component 1: Improving Energy Efficiency and Resilience of the Cutzamala System (US$60 million, all of which IBRD)

2. This component will: (i) strengthen information, monitoring, and control systems for the effective operation of the Cutzamala System and (ii) improve the safety and reliability of the infrastructure of the Cutzamala System for the delivery of water to the VMMA and the TMA**.** These activities will support Cutzamala System's operators in adapting to changing climate conditions, including droughts and other climate change-induced shocks to water quality and availability and thus build resilience to climate change by improving data monitoring and collection systems of these risks. The dam-related activities will improve the system's ability to control climate change-induced flooding.

Sub-component C1.1: ***Designing, modernizing and implementing infrastructure information systems for resilience of the Cutzamala System***

3. This sub-component will finance the modernization and expansion of existing data, information, and control systems for WRM in the Cutzamala System. It will provide tools for CONAGUA staff and other stakeholders that will enable more effective operation of the Cutzamala System and more effective management of water resources in the contributing basins through, inter alia:

a. The improvement of the data collection network to feed a Decision Support System for the management of water resources in the Cutzamala basins, including:

   i. The rehabilitation of nine automated weather stations (AWS) and installation of seven AWSs. The selection of these AWS will be the result of the critical analysis and redesign of the existing hydrometeorological and climate data acquisition network in the contributing sub-basins.

   ii. The purchase and installation of piezometric instrumentation for groundwater monitoring in the contributing sub-basins of the Cutzamala System through the instrumentation of 25 wells to gather piezometric and temperature data; and 25 wells to gather piezometric, temperature, and water quality data.

   iii. Hydrometric instrumentation of reservoirs and open-air conveyance channels (rivers and canals) to monitor water distribution and use, including reservoir water quality, through the

rehabilitation of 12 existing hydrometric stations; installation of five new hydrometric stations; installation of nine floating water quality gauges at reservoirs.

iv. The instrumentation of the Cutzamala System Dams related to dam safety through the installation of six water level gauges at dams; the installation of dam safety monitoring instruments, such as seepage measurement devices, piezometers, strain gauges, geodetic survey monuments, seismometers, etc.; and an automated data collection system to aggregate information from censors/gauges across the Cutzamala System.

b. The revision and updating of the existing supervisory control and data acquisition (SCADA) of the Cutzamala System, which has been in place since 2000 and is reaching the end of its design life. Given the age of the existing system, spare parts, hardware, and software support are often unavailable. Activities would include:

i. Analysis of all existing SCADA components; analysis of existing protocols for Cutzamala System operation, including diversion, water flow, and conveyance; design of the automation of the SCADA.

ii. Replacement of Programmable Logic Controllers; installation of remote management consoles; updating of monitoring software for key pumping facilities, the water treatment plant, dams, and tanks.

iii. Installation of closed-circuit TV monitoring equipment to support the physical security of equipment.

iv. Rehabilitation of the existing Control Supervision Center facilities for CONAGUA personnel to manage and oversee the Cutzamala System, including equipment to receive, integrate, and analyze data generated by instrumentation of information systems.

c. The design and implementation of a Decision Support System that includes the integration and visualization of data collected from monitoring systems in the Cutzamala basins and related infrastructure and the SCADA system. This will support CONAGUA to carry out water balances, water allocation, and the overall operation of the Cutzamala System.

Sub-component C1.2: ***Improving energy efficiency and reliability of the system's infrastructure***

4. This sub-component will finance the rehabilitation of Cutzamala System dams and the implementation of energy efficiency activities. Rehabilitation works envisioned for the Cutzamala System dams will serve as a pilot for dam safety initiatives elsewhere in Mexico under the set of norms published in the period 2015-2018. Specific activities include, inter alia:

a. Engineering analysis and design for a reversible pressurized transmission line to convey water to the Villa Victoria reservoir (as indicated in

b.

c.

d. **Figure 1**), the civil works and electro-mechanical work refurbishment for dam rehabilitation and safety improvement and the civil works and electro-mechanical work for energy efficiency activities. The notional designs for the Villa Victoria pressure line envision a conveyance pipe of approximately 26 km in length and some 99 inches in diameter that would increase water flows into the Villa Victoria reservoir. The pressure line would replace the existing open-air Héctor Martínez de Meza canal (see **Figure 2**). The engineering analysis will determine the specific layout of the pressure line and associated infrastructure (surge wells, pumping stations, control gates, etc.). The pressure line would allow for better control overflows of water into Los Berros water treatment plant and in turn will improve the ability of the Cutzamala System to meet bulk water delivery targets for the VMMA and the TMA. Also, detailed safety assessments of the dams, including hydrological assessment, downstream hazard, geotechnical investigation, etc. would provide the basis for detailed designs of those dams' rehabilitation/safety improvement works. Given the more strategic use of the Villa Victoria reservoir coupled with pressured line system, the safety and resilience of the storage dam against external shocks should be more critical. The engineering analysis of energy saving activities could include: (i) pumps and pumping systems operations that may entail replacing inefficient pumps, installation of variable frequency drives, utilization of gravity-fed systems, optimization of pumping system operations and improvement of maintenance; (ii) replacement of old pipes with new ones to improve efficiency; (iii) water loss management technologies that reduce leakages and manage pressure; and (iv) use of new technologies to implement supervisory control and data acquisition (SCADA) software, installation of smart pumps, and deployment of renewable energy generation options such as solar photovoltaic generation and small hydropower.

e. The development or upgrading of operation and maintenance and emergency preparedness plans for the Cutzamala System dams.

f. The rehabilitation and safety improvement of the Cutzamala System dams (Villa Victoria, Chilesdo, Colorines, Valle de Bravo, El Bosque, Ixtapan del Oro, Tuxpan, and Tilostoc), including, inter alia, civil works for dam structures, foundations, and associated infrastructure; and refurbishment and/or replacement of electrical and mechanical equipment (such as pumps, intake gate controls, back-up generators).

Figure 1. Cutzamala System Schematic with and Without Proposed Villa Victoria Pressure Line

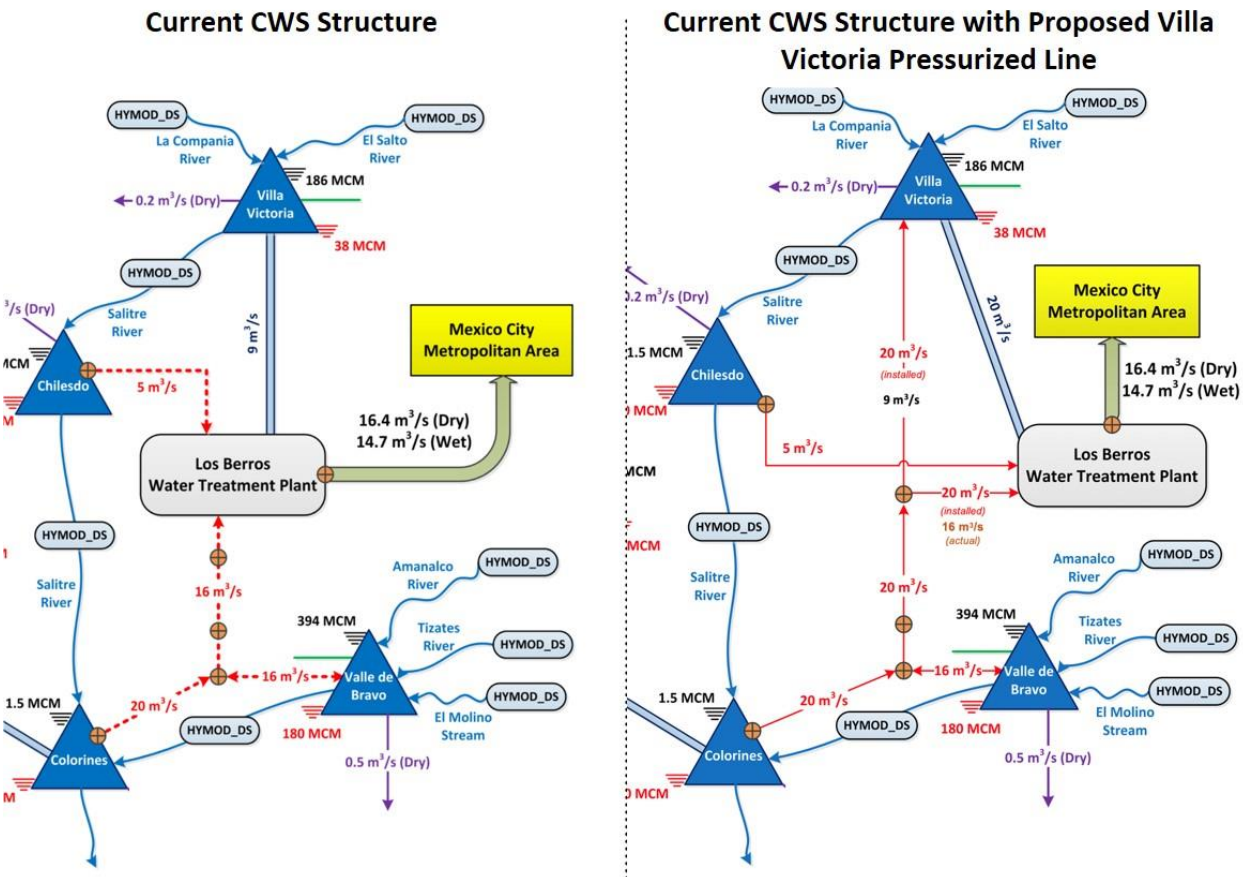


Figure 2. Existing Channels and Notional Villa Victoria Pressure Line

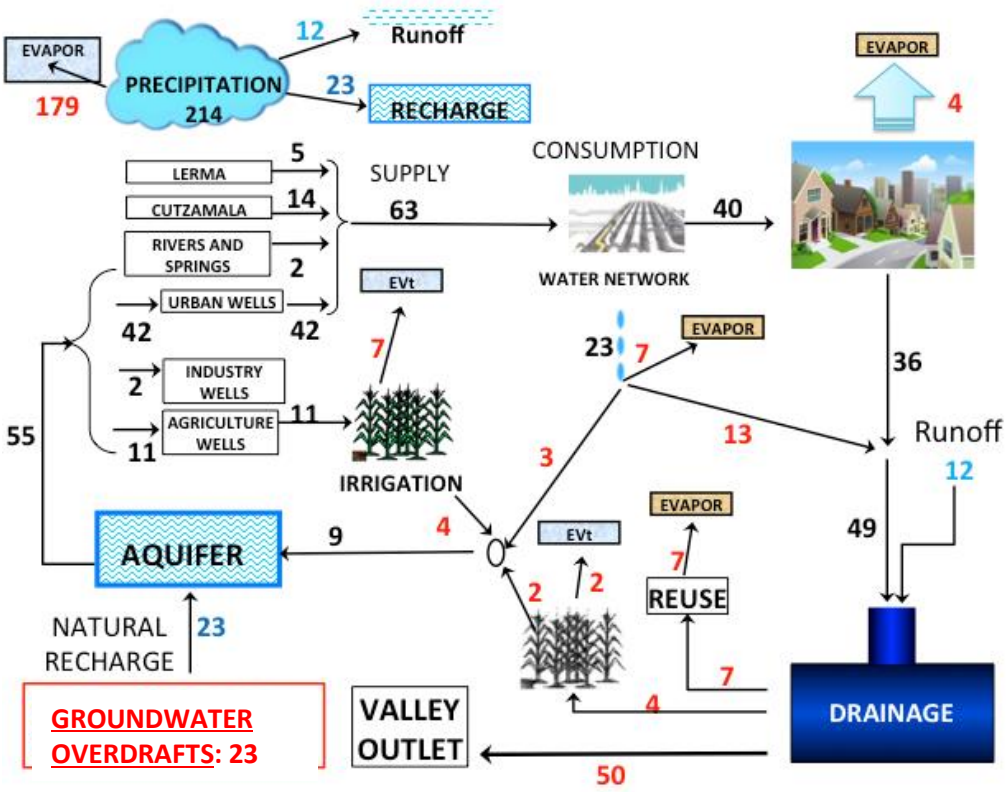
g. The implementation of energy efficiency activities.

h. The hiring of a works supervisor firm to support CONAGUA in the supervision of the design and implementation of all civil works and the installation of electrical and mechanical equipment.

Component 2: Groundwater Management and Recharge Pilot infrastructure in the Valley of Mexico (US$ 54 million, all of which IBRD)

5. The objectives of this component are to: (i) improve the availability of and timeliness of information for groundwater management through an Aquifer Observatory; and (ii) support pilot initiatives for managed aquifer recharge. This component will promote the sustainable management of the aquifers and begin to address overdrafting issues, illustrated in Figure 3.

Figure 3. Water Balance in VMMA



Sub-component C2.1: Designing and implementing an aquifer observatory for the Valley of Mexico

6. This sub-component will put tools in place for the effective monitoring and management of groundwater resources in the VMMA through support for the design and operationalization of an Aquifer Observatory for the Valley of Mexico. It will finance, inter alia:

a. The collection of baseline data and the preparation of a diagnostic for water quality and quantity of aquifers (see a schematic of the aquifers in Annex 5, Map 1), including pumping tests from approximately 20 wells throughout the VMMA.

b. The preparation of an inventory of wells within the Valley of Mexico, including water user data, which will update the previous inventory published in 2007 and provide critical information for the effective management of the VMMA aquifers.

c. The expansion and automation of the piezometric network of the Valley of Mexico, to monitor monthly groundwater variations, including: (i) a diagnostic of existing wells that comprise the groundwater monitoring network; (ii) selection of sites for new groundwater monitoring wells; (iii) construction of new groundwater monitoring wells based on the results of the technical analysis and calibration of new and existing wells; and (iv) automation of data collection from the piezometric network.

d. The improvement of the existing aquifer modeling tool to produce water balances and the dissemination of information, including the incorporation of new data sources and the simulation of aquifer responses at monthly time steps.

Sub-component C2.2: Carrying out infrastructure works for managed aquifer recharge initiatives in the Valley of Mexico

Managed aquifer recharge with treated wastewater effluent is an innovative approach to address the challenges of groundwater overdraft and attendant problems, including land subsidence. The GoM, in partnership with UNAM, has conducted extensive analytical work into the applicability of managed aquifer recharge for the Valley of Mexico and seeks Bank support to test the approach through two pilot initiatives. Pilots would involve the upgrading of existing wastewater treatment plants to incorporate tertiary treatment that results in effluent suitable for injection into aquifers through recharge wells. The GoM has identified a list of seven possible sites where MAR would be piloted in conjunction with existing wastewater treatment facilities (see

7. **Table 1** and Map 1 in Annex 5).

Table 1. List of Potential Aquifer Recharge Pilot Sites

Site	Infiltration Potential (l/s)
Zumpango	1000
Nextlalplan	1000
El Caracol*	1000
Contracorriente[+]	500
Lodos activados[+]	1000

Chapultepec*	180
Cerro de la Estrella	1000
San Juan Ixtayopan	250
Ríos del Oriente	300

* Indicates sites with government funded pilots in the early design stage
+ Contracorriente and Lodos activados are located on the same site and considered one pilot

8. This sub-component will finance, inter alia:

a. Engineering and technical studies will include, inter alia:

i. Geophysical analysis to identify sub-soil properties and to establish locations for monitoring and recharge wells within GoM owned premises (all sites must allow for all civil works to take place adjacent to existing WWTPs on vacant land owned by the Government).

ii. Water quality analysis to evaluate current groundwater conditions and wastewater treatment plant effluent characteristics to establish appropriate technologies required to meet prevailing Mexican discharge and groundwater recharge standards (NOM-014-CONAGUA-2007). Possible technologies under consideration for the advanced treatment modules include reverse osmosis, chemical treatment to remove phosphorous, and ultraviolet for disinfection. The results of this analysis will determine the types of upgrades needed to existing wastewater treatment plants.

iii. Engineering designs for the two pilot recharge projects.

b. The carrying out of civil works and the acquisition and installation of electrical and mechanical equipment for the upgrading of existing wastewater treatment plants to improve wastewater effluent quality by incorporating advanced treatment modules to comply with Mexican water quality discharge standards (based on the analysis carried out under Sub-component 2.2.a.ii).

c. Civil works for the construction of aquifer recharge wells or the upgrading of existing facilities to transfer treat effluent to aquifers (as informed by the site selection and engineering analysis completed through Sub-component 2.2.a).

d. Upgrading of existing conveyance infrastructure or construction of new conveyance infrastructure (as informed by the engineering analysis completed through Sub-component 2.2.a) from the WWTPs to the recharge wells.

9. Sub-component 2.2 adopts a framework approach in which specific pilot investments will be defined during implementation based on engineering analysis and borrower priorities and in compliance with established eligibility criteria. Specific pilots approved for financing under the Project will need to comply with the technical, economic, financial, institutional, and environmental and social criteria established in the Project's Operational Manual. Consultation and disclosure requirements also apply based on the specifications of each pilot. Potential pilot projects will be subject to the following screening process: i) alignment with Project development objective; ii) compliance with

eligibility criteria as established in the Operational Manual; and iii) demonstration value and potential for replicability from the specific site and technology selection.

Component 3: Institutional Strengthening and Project Management (US$5.7 million, all of which IBRD)

10. The objective of this component is to strengthen the capacity of the institutions involved in Project implementation and ensure financing and satisfactory performance of the PIU. This includes, inter alia:

a. Financing of all activities of the PIU needed to implement the Project, including hiring of core personnel and expert consultants.

b. Capacity building for CONAGUA personnel to strengthen (i) water infrastructure operation and groundwater management, (ii) citizen engagement, including outreach and dissemination activities, and (iii) leadership and technical training for female staff and gender awareness training for CONAGUA's staff.

ANNEX 2: THEORY OF CHANGE

1. The objectives of the Project are to improve the reliability[27] of the Cutzamala System and strengthen the management[28] of groundwater resources in the Valley of Mexico. These objectives are expected to contribute to a higher-level, longer-term objective of improving the water security and enhancing the resilience for the population in the Valley of Mexico's Metropolitan Area.

2. The Project design envisages key structural measures for bulk water supply, dam rehabilitation, energy efficiency, and aquifer recharge, coupled with the strengthening of information, monitoring, and control systems that will serve as tools for improving the reliability of the Cutzamala System and the effective management of ground and surface water. The Project is designed in three components: (i) Improving Energy Efficiency and Resilience of the Cutzamala System; (ii) Groundwater Management and Recharge Pilot Infrastructure in the Valley of Mexico; and (iii) Institutional Strengthening and Project Management. The results chain that describes how the project activities in each component as inputs, are expected to translate into project outputs, intermediate outcomes, project level outcomes, and contribution to the longer-term outcomes/impacts, is presented in the Theory of Change Table 1.

3. The theory of change is based on the following assumptions:

A1: GoM will provide the necessary support to implement and move forward with its commitments.
A2: CONAGUA budgetary planning effectively includes projects activities related to the project
A3: Cutzamala transfer volumes are not increased beyond average of 15 m3/s
A4: Additional efforts are made to limit the aquifer withdrawals in the Valley of Mexico
A5: Relevant staff have the technical capacity to interpret and analyze the data and information collected
A6: The Cutzamala system is managed by staff that with the necessary capacity to implement the SCADA system
A7: Technical expertise available to implement the energy efficiency investments
A8: CONAGUA has the team required to implement the dam safety works
A9: CONAGUA maintains a PIU with the core personnel to implement the project

[27] Reliability is defined as the percentage of days in which the system successfully supplies the target delivery to Mexico City. This is a widely used metric for the reliability of bulk water systems. Current reliability of the Cutzamala System is estimated at 82 percent (World Bank Decision Tree report 2017).
[28] This includes groundwater monitoring and aquifer recharge.

Table 2. Theory of Change

Component	Inputs	Outputs	Intermediate outcomes	Project Outcomes	Impact
Component 1: Improving Energy Efficiency and Resilience of the Cutzamala System				• Improved reliability of the Cutzamala System for the delivery of water to the Valley of Mexico Metropolitan Area and the Toluca Metropolitan Area	Improved water security and enhanced resilience in the Valley of Mexico
1.1 Designing, modernizing, and implementing infrastructure information systems for resilience of the Cutzamala System	• **Data Collection Network**: includes rehabilitation of existing network, the acquisition and installation of a hydrometeorological and climate network, a water quality monitoring network, a groundwater monitoring network, a network to monitor reservoir and canal levels to measure water distribution and use, and the acquisition and installation of monitoring equipment for the Cutzamala System Dams.	• Data collection network improved to effectively feed into a decision support system for the management of water resources in the Cutzamala basins.	• Quality of information (hydrology, water balances, allocation) and overall operation of Cutzamala system improved for CONAGUA. • Information and control systems for water resources management in the Cutzamala system modernized and strengthened, for improved decision making.		
	• **Supervisory control**: includes analysis of all existing SCADA components, replacement of programmable logic controllers, installation of remote management consoles, closed-circuit TV monitoring equipment, and rehabilitation of control supervision center facilities for CONAGUA personnel.	• Existing supervisory control and data acquisition (SCADA) of the Cutzamala system are revised and updated.			
	• **Decision Support System**: includes the integration, modelling and visualization of data collected from Cutzamala basins and SCADA systems.	• Design and implementation of a decision support system completed.			
1.2: Improving energy efficiency and reliability of the system's infrastructure	• **Engineering analysis and designs** for: i) a reversible pressurized transmission line to convey water to the Villa Victoria reservoir, ii) the rehabilitation works for the Cutzamala System and iii) the civil and electro-mechanical works for energy efficiency activities.	• Engineering designs completed for the works needed to improve energy efficiency and Cutzamala's system infrastructure.	• Improved preparedness for the changing climate conditions including droughts and other climate change-induced shocks to water quality and availability. • Improved efficiency in energy use. • Improved Cutzamala System dam safety.		
	• **O&M and Emergency Preparedness Plans:** Development or upgrading of operation and maintenance and emergency preparedness plans for the Cutzamala System dams.	• Operation and maintenance and emergency preparedness plans updated for the Cutzamala System dams.			

	• **Rehabilitation and safety improvement:** Civil works for dam structures, foundations, and associated infrastructure, and electrical and mechanical equipment refurbishment and/or replacement in the Cutzamala System Dams, including Villa Victoria, Chilesdo, Colorines, Valle de Bravo, Elbosque, Ixtapan del Oro, Tuxpan, and Tilostoc,	• Cutzamala System Dams Rehabilitated.		• Improved decision making on groundwater management	
	• **Energy efficiency:** Implementation of energy efficiency activities	• Energy efficiency activities completed.			
	• **Work Supervision:** Hiring of a works supervisor firm to support CONAGUA in the supervision of the design and implementation of all civil works and the installation of electrical and mechanical equipment	• CONAGUA's capacity to supervise its civil work enhanced.			
Component 2: Groundwater Management and Recharge Pilot Infrastructure in the Valley of Mexico					
2.1: Designing and implementing an aquifer observatory for the Valley of Mexico	• **Acquirer Observatory diagnostics:** Includes collection of baseline data and preparation of a diagnostic for water quality and quantity of aquifers	• Aquifer Observatory is operational and used as an effective tool to monitor and manage the groundwater resources in the Valley of Mexico metropolitan area.	• Improved availability of and timeliness of information for groundwater management • Enhanced monitoring and management of the Valley of Mexico aquifers.	• At least one managed aquifer recharge pilot operationalized.	
	• **Inventory of Wells:** preparation of inventory of wells within the Valley of Mexico, including water user data.	• Previous inventory from 2007 updated.			
	• **Piezometric network:** (i) diagnostic of existing wells that comprise the groundwater monitoring network; (ii) selection of sites for new groundwater monitoring wells; (iii) construction of new groundwater monitoring wells; and (iv) automation of data collection from the network.	• Expansion and automation of piezometric network to monitor monthly groundwater variations.			
	• **Aquifer modelling tool**: improvement of the existing tool to produce water balances and dissemination of information, including the Incorporation of new data sources and simulation of aquifer responses at monthly time steps.	• Existing aquifer modelling tool improved.			

2.2: Carrying out infrastructure works for managed aquifer recharge initiatives in the Valley of Mexico (Framework approach in which pilot investments will be defined during implementation based on established criteria)	• **Engineering and technical studies:** Geophysical analysis to identify sub-soil properties, water quality analysis to evaluate current groundwater conditions and wastewater treatment plant effluent characteristics, and engineering designs for the two pilot recharge projects.	• Studies, analysis, and technical designs completed and monitoring, recharge well locations defined for pilot projects.	• Pilot initiatives to upgrade the existing wastewater treatment plants to incorporate tertiary treatment for managed aquifer recharge completed • Recharge pilots projects are contributing to the sustainability of the Valley of Mexico groundwater.		
	• **Civil works and electrical and mechanical equipment:** existing wastewater treatment plants upgrades to improve wastewater treatment plants according to national quality discharge standards.	• Civil works and electrical mechanical equipment work completed.			
	• **Aquifer recharge wells:** civil works for the construction of aquifer recharge wells or the upgrading of existing facilities to transfer treated effluent to aquifers.	• Civil works for construction or upgrading of aquifer recharge wells completed.			
	• **Conveyance Infrastructure:** Upgrading of existing conveyance infrastructure or construction of new conveyance infrastructure from the wastewater treatment plants to recharge wells.	• Wastewater conveyance infrastructure completed.			
Component 3: Institutional Strengthening and Project Management					
Institutional strengthening and capacity building for project implementation unit	• **PIU activities:** Financing of all activities of the PIU needed to implement the project, including core personnel and expert consultants.	• PIU activities implemented.	• PIU and CONAGUA capacity strengthened. • Project implemented in an inclusive and timely manner.		
	• **Capacity building for CONAGUA:** strengthening of water infrastructure operation and groundwater management, citizen's engagement, and leadership and technical training for female staff and gender awareness training for CONAGUA staff.	• All training and capacity building activities completed.			

ANNEX 3: IMPLEMENTATION ARRANGEMENTS

COUNTRY : Mexico
Water Security and Resilience for the Valley of Mexico

Project Institutional and Implementation Arrangements

1. **The 1917 Mexican Constitution and Federal laws establish the framework for water management and governance in Mexico.** Per the Constitution, all water resources belong to the federal government, while local governments are responsible for water service provision. A series of federal laws lay out the principles and mechanisms for the constitutional mandates surrounding water management. The National Water Law of 1992 defined the current regulatory structure and identifies CONAGUA, a deconcentrated and technically autonomous agency of the Ministry of Environment and Natural Resources (*Secretaría del Medio Ambiente y Recursos Naturales*, or SEMARNAT), as the central administrative authority for the water sector and charges it with i) the design of sector strategy; ii) formulation of sector policy; iii) construction of drinking water and wastewater treatment facilities; iv) construction, operation and maintenance of dams; v) collection of water resources fees; and v) transfer of federal fiscal resources to municipalities for water infrastructure and service provision. River basin organizations, subsidiary entities of CONAGUA, of which there are 13 across the country, plan, build, operate, and maintain federal water infrastructure.

2. **OCAVM is the river basin organization responsible for the administration, management and oversight of water resources in the administrative hydrological region XIII, Aguas del Valle de México.** OCAVM distinguishes itself from the other 12 Basin Organizations in the country since it operates water systems for the delivery of bulk water supply, such as the Immediate Action Plan Wells within Region XIII, and the Cutzamala System in Region IV, Balsas. OCAVM delivers bulk water to SACMEX and the State of Mexico Water Commission who are in turn responsible for water supply and sanitation services.

3. **This Project will be implemented by CONAGUA.** A Project Implementation Unit (PIU) housed within CONAGUA will provide technical and administrative support to ensure full implementation of each project activity. The PIU will be headed by a coordinator and supported by, at minimum, a financial management specialist, a procurement specialist, an M&E specialist, an environment specialist, and a social specialist, as detailed in the Operational Manual and verified through the annual external audit.

4. A successful Project implementation will require significant coordination and compatibility between existing infrastructure and procedures with the incorporation of new tasks, equipment and technology. The PIU will facilitate all actions of the Project at various levels of CONAGUA, with federal entities, river basin authorities, state and municipal governments, and consumer groups.

Financial Management

5. **Loan Financial administration**. The newly created Wellness Bank (*Banco del Bienestar,* BdB in Spanish), formerly National Savings and Financial Services Bank (*Banco del Ahorro Nacional y Servicios Financieros*, BANSEFI) will act as the financial agent appointed by the Government for the loan. In that capacity, BdB will manage loan disbursement processes and provide overall implementation support and oversight, including for FM and procurement.

6. **Budgeting arrangements**. Budget for the Project will be allocated from the Federal budget approved to the Environment and Natural Resources Sector (SEMARNAT) through the Federal Annual Budget ('Presupuesto de Egresos de la Federación').

7. Civil works and investments for which the execution period could go beyond one fiscal year will require multi-year investment and contracting approval according to specific budgetary regulations issued by the Ministry of Finances ('*Unidad de Inversiones de la Secretaría de Hacienda y Crédito Público'*, Public Investment Unit within the Ministry of Finance and Public Credit), and will also need to be incorporated in the Public Investments management system, through which public infrastructure investments are managed, following strict prioritization and selection processes.

8. Project budget will be executed and controlled following the country budget legal framework and regulations. Project transactions and budget control will be incorporated and managed through the accounting and budgetary institutional systems in place, and there will not be Government counterpart financing. Project investments and expenditures will be solely financed with Bank (loan) proceeds.

9. **Accounting and budget systems**. CONAGUA keeps accounting records and budget control through the accounting and budget systems in use at country (federal) level. The '*Sistema de Contabilidad y Presupuesto'* (SICOP, for its acronym in Spanish) is used for institutional accounting records, and the '*Sistema Integral de Administracion Financiera Federal'* (SIAFF, for its acronym in Spanish), linked to the National Treasury ('*Tesorería de la Federación'*, TESOFE for its acronym in Spanish) is used for budget execution and control.

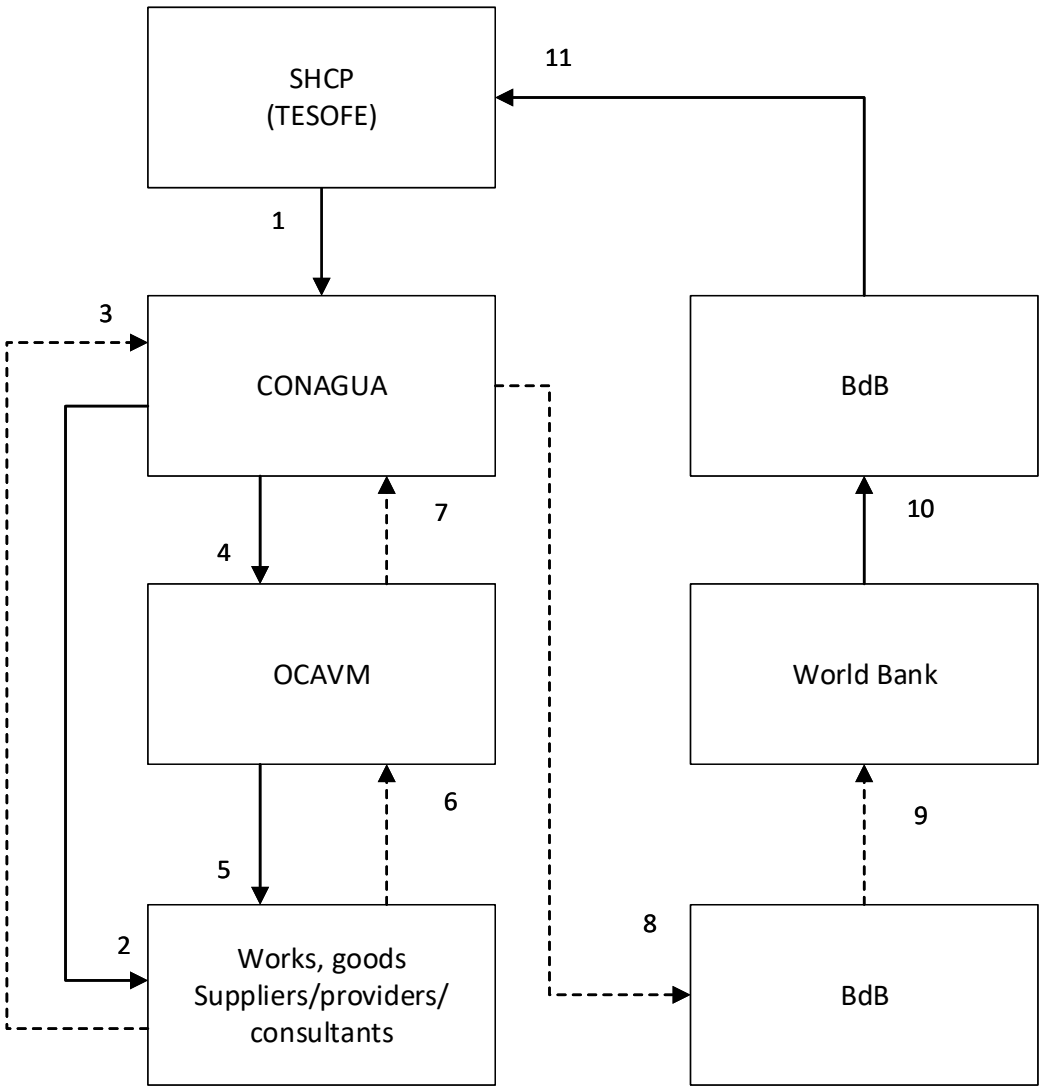
10. The project's financial reports will be prepared semiannually based on the standard model agreed with the Ministry of Public Administration ('*Secretaría de la Función Pública'*, SFP for its Spanish acronym) for the Mexico portfolio, incorporating additional information on financial and physical progress of civil works investments.

11. **Internal control and internal auditing**. CONAGUA is subject to robust control mechanisms and regulatory provisions under the federal budget framework, including specific regulations on public investment management, and also to the Federal Public Administration Internal Control Standards issued by the SFP, which as a whole provide for sound internal control arrangements for the Project.

12. The internal auditing function is carried out by CONAGUA's Internal Control Unit ('*Organo Interno de Control'*) which reports to the SFP and must follow Public Audit Standards and guidelines issued by SFP. The latter also approves the Internal Control Unit's annual work program, oversees its operation and receives its audit reports. Robust systems are in place for timely follow-up to internal audit observations and implementation of recommendations, in terms satisfactory to the Bank. Within CONAGUA, a specific administrative unit ('*Coordinación de Atención a Organismos Fiscalizadores'*), is responsible for internal coordination of the audit process and following up findings issued by the external auditor.

13. CONAGUA is also within the scope of audit of the Supreme Audit Institution ('*Auditoria Superior de la Federación'*), which is independent from the three levels of Government in Mexico.

Flow of Funds



Solid Line: Funds Flow
Broken Line: Information Flow

1. Based on the budget approved annually by the Congress (through the '*Presupuesto de Egresos de la Federación*', PEF), the National Treasury ('*Tesorería de la Federación*', TESOFE), transfers allocated budget to CONAGUA.
2. CONAGUA makes payments to contractors / suppliers / providers / consultants.
3. Contractors / suppliers / providers / consultants provide support documentation to CONAGUA.

4. CONAGUA transfers funds to OCAVM.
5. OCAVM makes payments to contractors / suppliers / providers / consultants.
6. Contractors / suppliers / providers / consultants provide support documentation to OCAVM.
7. OCAVM provides support documentation to CONAGUA, to prepare disbursement applications.
8. CONAGUA prepares and submits to BdB support documentation and requests disbursement.
9. BdB reviews disbursement request and support documentation and submits the disbursement application to the World Bank.
10. The World Bank disburses loan proceeds to BdB.
11. BdB transfers disbursed loan proceeds to TESOFE.

14. **External Audit**. Annual audits on Project financial statements and eligibility of expenditures will be performed in accordance with Bank requirements, as reflected in the Audit Terms of Reference and Memorandum of Understanding agreed between the World Bank and the Government of Mexico, through the SFP. An independent audit firm appointed by SFP and acceptable to the Bank will conduct the Project audits. The Bank may accept to finance the cost of the external audit with loan proceeds.

15. Audit terms of reference for the annual financial audit will require independent auditors to report on the actual use of funds ensuring that Project funds are used for the intended purposes, in an efficient and effective manner.

Disbursements

Disbursement method	The following disbursement methods may be used under the loan: • Reimbursement.
Supporting documentation	Statements of Expenditure (SOE), Invoices and Receipts.
Retroactive expenditures	Eligible payments must meet the following conditions: ▪ Payments made during a period of up to one year before the date of the loan agreement is signed. ▪ That do not exceed 20 percent of the loan amount. ▪ The retroactive expenditures would be subject to the same systems, controls and eligibility filters described above. Those expenditures would also be subject to the regular Project external audit.

Procurement

16. Procurement for the Project will be carried out by CONAGUA. The Project will be executed in accordance with the World Bank's Procurement Regulations for IPF Borrowers – July 2016 and revised November 2017 ("Procurement Regulations"), and the provisions stipulated in the Loan Agreement. The various items under different expenditure categories are described in general below. For each contract to be financed by the loan, the different procurement methods or consultant selection methods, estimated costs, prior review requirements, and time frame are agreed between the Borrower and the Bank in the Procurement Plan. The Procurement Plan will be updated in the Systematic Tracking of Exchanges in Procurement system (STEP) whenever required to reflect the actual Project implementation needs.

17. **Procurement Arrangements:** A Project Procurement Strategy for Development (PPSD) was carried out and identified the appropriate approach as follows:

18. Civil Works would include: dam rehabilitation; installation of oxygenation equipment in dams; drilling of exploratory wells and; conduction and rehabilitation of existing wells, PAI´s system and monitoring wells. Procurement methods would include Request for Bids / Open / International and National.

19. Goods would include: Piezometric instrumentation; supervisory control center; engines for pumping plants and repair of plant pumps; service supply to spherical valves of the pumping plants; hydrometric instrumentation; rehabilitation and purchase of new Automatic Meteorological Stations; electrical backup equipment; automation, maintenance and expansion of the piezometric monitoring network and; revision and updating of the SCADA of the Cutzamala System. Procurement methods would include Request for Bids / Open / International and National.

20. Non-Consultant Services would include: monitoring and information processing services. Procurement methods would include Request for Bids / Open / International and National.

21. Consultant Services would include: engineering analysis and design; cost-benefit analysis; supervision of civil works and of the installation of electrical and mechanical equipment; specialized studios; and consulting services needed by the PIU implement the Project. Most contracts for firms carried out by CONAGUA are expected to be selected using the Quality- and Cost-Based Selection Method (QCBS). Consultant assignments of specific types, as agreed previously with the Bank in the Procurement Plan, may be selected using the following selection methods: (i) Quality-Based Selection (QBS); (ii) Selection under a Fixed Budget (SFB); (iii) Least- Cost Selection (LCS); (iv) Selection Based on Consultants' Qualifications (CQS); and exceptionally (v) Direct Selection (DS), under the circumstances explained in paragraph 7.13 to 7.15 of the Regulations. Individual consultants will be hired to provide technical advisory and Project support services and will be selected in accordance with the comparison of at least three CVs.

22. The World Bank's Standard Procurement Documents will govern the procurement of World Bank financed Open International Competitive Procurement. For procurement involving National Competitive Procurement, the procurement documents to be used will be agreed with the Bank through the Procurement Plan.

23. **Assessment of the Implementing Entities' Capacity to Implement Procurement**. A procurement capacity assessment was carried out to CONAGUA in November 2017 and updated in November 2019. The assessment reviewed the organizational structure, the staff responsible for procurement and the systems used for supervising and controlling. The analysis concluded that CONAGUA is an entity that operates under a clearly defined legal framework with clear internal procedures with long experience in the implementation of Procurement activities financed by the Bank. CONAGUA has demonstrated sound capacity in implementing World Bank procurement policies and procedures. Additionally, BdB, will act as the financial agent for Project's implementation, which will reinforce the quality of the procurement procedures. Considering the complexity of the activities the overall Project risk for procurement is Moderate. A dedicated Procurement Specialist shall be included in the staff of the PIU.

24. **Risk Mitigation Plan.** The following table summarizes the mitigation actions proposed for the procurement-related risks identified below.

Procurement Action Plan

Risks	Mitigating Actions	Participants	
Lack of experience in the application of the Procurement Regulations	Workshop in the Regulations with emphasis in: • PPSD • Bidding Documents • STEP • Contract Management	**Trainer:** APS of The World Bank **Participants:** CONAGUA (including OCAVM and any other area linked with any step of the Procurement activities) and BdB.	Q3 FY 20
	Workshop in the preparation of Bidding Documents.		Q3 FY 20
	Workshop in Evaluation of Bids and Proposals		Q4 FY 20
Market conditions	Based on the supply positioning model, 11 activities (representing 48 percent of the Project's budget) were selected, considering its risk and amount, to include a specific market analysis.	CONAGUA with the support of BdB and The World Bank.	
Project Management	The Procurement section of the Operational Manual must contain a clear definition of the processes, roles, and responsibilities inside CONAGUA. The Procurement Plan prepared by CONAGUA indicates that 48 percent of Procurement Plan budget subject to prior review by the Bank.	CONAGUA CONAGUA with the support of BdB and The World Bank.	

25. **Procurement Plan.** A Procurement Plan was prepared by CONAGUA and will be uploaded to STEP. The Procurement Plan will be updated as necessary and required to reflect actual Project implementation needs and improvements in institutional capacity. A General Procurement Notice will be published through STEP.

26. **Project Operational Manual (POM).** The Project Operational Manual covers the relevant procurement processes, including detailed institutional procedures, accountabilities, composition of technical and administrative evaluation committees, time frames for approvals, etc. The POM also covers topics related to conflicts of interest, fraud and corruption.

27. **Bank supervision.** Bank procurement staff will undertake at least two missions in the first two years after the Project has been declared effective to monitor and review compliance with Procurement policies. Based on the initial Procurement Plan, an estimated 20 percent of the activities, representing 48 percent of the Procurement Plan's Budget, will be prior reviewed by the Bank.

Environmental and Social (including safeguards)

28. The Project activates OP 4.01 on Environmental Assessment and is classified as Environmental Category B. The expected negative environmental impacts are relatively limited in scope and magnitude, and CONAGUA has successful experience in the implementation of the associated mitigation measures. The possible negative environmental impacts are associated with activities and works to be carried out in areas with existing water abstraction, storage (dams), and conveyance infrastructure and within the pilot sites for recharging the aquifer in the Valle de Mexico with treated wastewater.

29. The Project includes works and activities for which the corresponding detailed designs have not been developed, and the construction procedures and technologies remain to be defined. Consequently, CONAGUA has developed, consulted and disclosed an Environmental and Social Management Framework (ESMF), which includes the necessary screening procedures to identify, evaluate and manage the possible environmental and social risks and impacts. The ESMF identifies the environmental requirements that must be met and will be included in the bidding documents and contracts. The bidding documents and contracts will require compliance with applicable Mexican laws and regulations, World Bank safeguard policies and implementation of standard good environmental practices. The ESMF covers: screening of potential works for environmental risks and impacts; carrying out a required environmental assessment to obtain regulatory authorization for each subproject and complementary works; and implementing necessary mitigation and monitoring measures. The ESMF also covers institutional capacity, training, supervision, monitoring and reports applicable to CONAGUA.

30. The Project activates OP/BP 4.10 on Indigenous Peoples and OP/BP 4.12 on Involuntary Resettlement. CONAGUA developed a Social Assessment (SA), a Resettlement Policy Framework (RPF) and an Indigenous Peoples Planning Framework (IPPF) that identify potential social impacts, the indigenous peoples present in the Project area, as well as relevant national bylaws and regulations and the provisions for complying with the World Bank safeguards requirements. This SA established the social baseline conditions in the Project area and identified social risks and appropriate measures to avoid, minimize, mitigate, or contain potential impacts, and report accordingly. The IPPF was based on the SA findings. The Project is not expected to have negative social impacts on indigenous peoples or other stakeholders. The Project alleviates risks of water shortages and social disruptions. No involuntary land taking or resettlement is expected as the Project will be implemented on government-owned land. In order to ensure the inclusion of indigenous peoples, the IPPF provides guidance for preparing IPPs where necessary.

31. CONAGUA has proven knowledge and experience in applying the activated World Bank environmental and social safeguards through several Bank-financed projects. Additionally, CONAGUA is implementing an institutional program for strengthening the capacity of technical personnel at local and federal level. All capacity building activities incorporate relevant safeguard principles and Environmental, Social, Health and Safety (ESHS) good practices. CONAGUA has successfully developed and managed mechanisms to deal with complaints, suggestions and requests for information based on the country's legal regulations: Constitution of the United States of Mexico, Transparency and Access to Public Information Federal Law, and Administrative Responsibilities of Public Servants Federal Law, among others.

32. Within CONAGUA, the implementation of the safeguard instruments will rely on a Safeguards Area within the PIU. Currently six staff are responsible for overseeing activities and implement, document, and follow up the activities of consultation, participation, dissemination and coordination related to the Project implementation, including activities related to compliance with the environmental and social safeguards and related reporting.

33. The supervision of Project activities will include evaluation of compliance with ESHS requirements, including cultural aspects. CONAGUA and the Project contractors will be responsible for the ESHS management of the Project works. Strong environmental clauses will be included in the terms of reference and contracts to indicate the obligation of the participating contractors to have the necessary management capacity related to ESHS aspects. Moreover, Component 3 and the ESMF foresee opportune capacity building measures.

Monitoring and Evaluation (M&E)

34. The Project's results framework is included as Section VII. It has been developed based on discussions with CONAGUA. The PIU will consolidate the data at the Project level and produce semiannual reports to monitor progress. These reports will indicate the progress made under the different components and measure performance against the results indicators established in the Results Framework. The semiannual progress reports will allow better monitoring of the implementation of agreed activities by also providing information on (a) investment and disbursement performance over the period covered by the report and an updated disbursement calendar; (b) procurement performance and an updated Procurement Plan for activities under each of the components and subcomponents of the Project; (c) accounting and financial management (FM) performance; (d) progress in the implementation of the ESMF, IPPF and RPF, including problems identified and documentation of positive environmental and social impacts in the areas of intervention; (e) potential developments that could affect Project implementation, including a review of the main risks and the impact of mitigation measures envisioned at appraisal; and (f) other operational and administrative information judged relevant by the PIU or the World Bank Task Team (TT) accompanying Project implementation. The second semiannual report of each calendar year should also include an annual operation plan for the following year. The PIU progress reports will be presented and submitted to the World Bank in accordance with the format established in the Project's Operational Manual.

35. At the mid-term evaluation of the Project, the TT and the PIU will undertake a detailed review of the M&E system to verify fulfillment of the agreed targets and compliance with other contractual commitments and recommend any necessary corrective action.

ANNEX 4: IMPLEMENTATION SUPPORT PLAN

COUNTRY : Mexico
Water Security and Resilience for the Valley of Mexico (PROSEGHIR)

Strategy and Approach for Implementation Support

1. The approach for the implementation support plan was built on the experience gained from the previous projects and the experience from ongoing projects in Mexico. It has also been developed based on the nature of the Project and its risk profile.

Implementation Support Plan and Resource Requirements

2. Most of the team members are based out of the Mexico country office, which ensures timely and effective implementation support to the client.

3. *Technical.* Specialized engineering, dam safety, hydraulic works and groundwater inputs are required to revise bidding documents to ensure fair competition through proper technical specifications and a fair assessment of the technical aspects of the bids. During preparation and construction, high quality technical supervision will be needed to ensure that contractual obligations and quality requirements are met, as well as to review any requested change in the selected technical method or design. The team, comprised of highly qualified national and international technical specialists, will conduct site visits on at least a semiannual basis throughout Project implementation. International experts will provide support to CONAGUA in the implementation of dam safety assessment and rehabilitation/upgrading works in accordance with the recently approved risk-based dam safety technical norms.

4. *Fiduciary*. Training will be provided by the Bank's FM and procurement specialists during Project implementation. The team will also help the PIU identify capacity-building needs to strengthen the FM capacity and improve procurement-management efficiency. Both FM and procurement specialists will be based out of the country office to provide timely and continuous support. Formal FM supervision will be carried out semiannually and procurement supervision will be carried out on an as-needed basis as required by the client.

5. *Safeguards.* The Bank team will support and supervise Project implementation closely in terms of the environmental and social management instruments and provide guidance to the PIU to address any issue. Country-based Environmental and Social Specialists will be available to help minimize potential risks and impacts.

6. *Thematic support*. The scope, nature, and objectives of the Project indicate that there will be a continuous need for dialogue, particularly in the areas of planning, institutional arrangements, and dam safety. The Bank TT expects that most of the dialogue will be led by Bank sectoral specialists.

Time	Focus	Skills Needed	Resource Estimate	Partner Role
First twelve months	Technical and procurement review of bidding documents	Technical Bank procurement Bank safeguards	Supervision budget	N.A.

	Procurement training Safeguards training			
12-48 months	Supervision and management of construction contracts Environmental and social monitoring Financial	Technical/construction experts Bank procurement FM M&E Social Environmental	Supervision budget	N.A.
Other	Drawing lessons learned and mainstreaming good practice	M&E Technical	Supervision budget	N.A.

Skills Mix Required

Skills Needed	Number of Staff Weeks	Number of Trips	Comments
Task Team Leader	12	0	Based in CO
WRM Specialist	2	2	Based in HQ
Environmental Specialist	6	1	Based in CO
Social Specialist	5	1	Based in CO
Lawyer	0	0	Based in HQ
Procurement Specialist	1	1	Based in CO
FM Specialist	4	0	Based in CO
Dam Safety Specialist	4	2	Based in HQ
Technical specialists (4)	6	6	Based in HQ and CO

Note CO: country office, HQ: Headquarters

ANNEX 5: ECONOMIC ANALYSIS

COUNTRY : Mexico
Water Security and Resilience for the Valley of Mexico (PROSEGHIR)

1. The benefits of the Project will not only accrue to individuals, but also to society in terms of strengthened public sector capacity to manage water resources and improved dam safety. The Project will also generate environment benefits such as reduced air pollution and reduced greenhouse gas emissions.

2. Energy efficiency measures will result in economic and financial benefits. On the economic side, energy efficiency measures will decrease the negative externalities by improving the efficiency of electromechanical systems, thus reducing the emissions of greenhouse gases, which also contributes to a reduction in air pollution levels. The possibility of generating electricity from renewable sources (i.e., solar) and the water in the canals reduces the use of electricity from fossil sources. On the financial side, energy efficiency activities will result in significant savings. CONAGUA spends 15 percent of its entire budget in the electricity costs for the Cutzamala system. Financial savings can be used to increase the level of investments in the system in order to increase its reliability.

3. Sub-components 1.1 and 2.1 are designed to strengthen and expand existing information systems to provide CONAGUA staff and other stakeholders with the tools they need to make informed decisions and to efficiently manage ground and surface water. Within the sub-basins, improved hydromet monitoring network will provide timely information on precipitation that will allow for better water allocation decisions among users and safer operation of the its infrastructure. Within the Cutzamala System itself, the monitoring of water levels and flows in reservoirs and canals will allow for more efficient and safer operation of System infrastructure. These information networks will also allow the System to respond more nimbly to maintenance issues or disasters. Similarly, the Aquifer Observatory will for the first time equip decision makers with the necessary information flows for effective management of the VMMA's groundwater resources.

4. Sub-component 1.2 aims to improve the resilience of the Cutzamala System and its ability to reliably deliver bulk water. As such, the benefits do not accrue directly to beneficiaries such as municipal drinking water customers, agriculture or industries, but rather to utilities that distribute the water supply. The economic benefits in terms of improve reliability and resilience are difficult to quantify. Instead, a cost-effectiveness analysis was conducted as part of a stress test of the Cutzamala System using the Decision Tree Framework that identified the vulnerabilities to exogenous factors (climate change, demographics, and land use). Following the stress test, adaptation investments listed in Table 2 were evaluated for their ability to reduce the vulnerability of the current system, and increase future resilience to change. The selection of investments was carried out through an optimization of cost-effective solutions that took other key performance indicators into account (drought response, robustness, resilience, reliability). The economic term used for the cost calculations is 30 years. The discount rate used is 10% and capital costs are spread over the first 5 years of the investment.

5. The analysis also evaluated the effects of optimized reservoir and canal operations. The results indicate that re-operating (Re-op in Table 2) the system provides benefits that are comparable or superior to many of the investment portfolios. However, there are significant political costs to attempt only to optimize the reoperation of the system, hence, there is a need to complement with additional investments. Coupled with some

reoperation of the system, the investments in Villa Victoria provide significant improvements in terms of reliability, resilience and drought performance, while minimizing costs.

Table 3. Cutzamala System Investment Alternatives

Investment Options	Overview of Benefit	Max Water Yield (MCM)		Reliability (%)		Resilience		Drought Performance		Cost (M$MXN)
		No action	Reop	No action	Reop	No action	Reop	No action	Reop	
Current System	Business as usual	469	521	94.57	98.72	9.66	28.57	0.8695	0.9906	-
Villa Victoria & Canal	50 MCM extra storage & 8m^3/s canal (Hector Martinez)	**468**	**529**	**94.14**	**97.83**	**31.91**	**34.74**	**0.9239**	**0.9868**	**5538**
Temascaltepec	Additional reservoir with capacity of 65 MCM.	558	572	98.49	98.13	31.82	31.71	0.9876	0.9898	19676
Tuxpan Irrigation	New canal for irrigators at Tuxpan (1.5m^3/s capacity)	469	525	94.14	98.04	9.73	31.40	0.8633	0.9860	2425
Villa Victoria Pressure Line	New pressurized tunnel (20m^3/s) to connect pumps to Villa Victoria and Villa Victoria to los Berros	**421**	**548**	**90.19**	**97.26**	**36.74**	**51.67**	**0.8426**	**0.9400**	**1600**

6. **Performance metrics.** Table 3 summarizes the performance metrics used in the evaluation of the performance of the Cutzamala water system. The first four performance metrics (i.e. reliability, resilience, maximum reliable yield and drought performance) were evaluated over the twelve-year historical period utilized for the construction of the system hydrological and hydraulic model (1999 to 2011). The robustness metric was evaluated over the 81 generated climate scenarios and 10 variability traces.

Table 3 Performance metrics

	Name	Description	Units
1	Reliability of supply to Mexico City	The percentage of days in which the system successfully supplies the target delivery to Mexico City.	%
2	Resilience of supply to Mexico City	The ability of the system to recover from the failure to meet the target release, calculated as the number of system recoveries over the total number of failures scaled by a factor of 100 for presentation purposes.	1/day * 100
3	Maximum reliable yield	Maximum yield of the system at a reliability of 95%.	m^3/s or Mm^3
4	Drought releases	The average release to Mexico City relative to the target release during the 18 month period in which releases to Mexico City are the lowest in the simulation.	%
5	Robustness	Capacity of the system to reliably release its target yield over various climate futures. Specifically, this is calculated as the percent of the total climate stress test area where the system performs satisfactorily.	%

7. The Villa Victoria Pressure Line engineering studies will be financed under sub-component 1.2. This subcomponent will also support the rehabilitation /safety improvement of the Cutzamala System dams and development of operation & maintenance and emergency preparedness plans. A recent inspection of the dams highlighted the high downstream risk based on the presence of homes and businesses located below spillways. Civil works for rehabilitation and safety improvement, coupled with refurbishment/replacement of aging electrical-mechanical control equipment, will reduce the risk of dam failure and resultant catastrophic flooding of downstream communities. Energy efficiency measures are expected to have cost-savings in the operation of Cutzamala infrastructure for OCAVM and a full energy audit and prioritization of investments will be conducted early in the implementation phase. Given that the specific schedule of rehabilitation works and energy efficiency measures have not been determined, a CBA is not feasible. The development of operation and maintenance and emergency safety plans for the Cutzamala System dams will likewise benefit local communities through a reduction in flood risk due to dam failure, though estimating a monetary value of these benefits poses significant methodological challenges.

8. Sub-component 2.2 is designed to support the implementation of pilot initiatives for managed groundwater recharge in the VMMA. Given that the parameters of pilot initiatives (including site, technology, and scope) will be defined during Project implementation, a thorough cost benefit analysis (CBA) is not feasible at appraisal stage. The direct benefits will largely accrue in terms of experience and demonstration value of the technology that can be scaled up in the future.[29] Scaled up implementation of MAR enabled by the pilots to be

[29] The expected volumes of aquifer recharge in each pilot are comparatively small relative to the scale of the overdraft, and thus the direct and measurable impact on water table levels, well drilling and pumping costs, or land subsidence is expected to be limited from the pilots alone.

supported under the Project will yield a broad range of benefits for the VMMA. As outlined above, effective MAR will stabilize soils, reduce land subsidence, lower the fall in water tables, and improve groundwater quality. These physical processes will translate to economic and quality of life benefits for residents, business, and public entities in the VMMA including:

a. *Reduction in Land Subsidence*. Mexico City faces costs of some US$1.4 billion per annum in damages to public infrastructure as roads, viaducts, rail lines, municipal water distribution systems, government buildings, and other infrastructure as land subsidence causes the city to sink at uneven rates (this figure does not include damages to private property and housing). Subsidence causes minor flooding of low-lying areas that has major implications for traffic and mobility. Reducing subsidence through MAR will benefit residents who are forced to cope with its adverse effects today.

b. *Drinking water supply, pumping costs, and emergency backup*. Water banked underground through MAR increases the resiliency of water service provision by serving as a buffer to supply interruptions caused by anything from routine maintenance to seismic events. Higher (or more slowly decreasing) water tables will mean lower (or more slowly increasing) pumping costs for groundwater and less need to drill deeper, construct new wells or bring water from other sources. The recharge of aquifers with treated water inflows will begin to reverse the decline in groundwater quality. International experience shows that the cost of MAR project with wastewater ranges from 10 to 12 MX$/m3. This solution needs to be compared against the costs of bringing water from other basins such as Temascaltepec which is currently estimated at 188 MX$/m3. The MAR initiatives can result in significant savings in investments, resources that can be used for improvements in maintenance of the system.

Public Sector Rationale

9. Public sector financing is especially relevant in WRM, where a public good is shared among different users and the regulatory power of the State is key to avoid negative externalities. In particular, the rationale for public sector financing for improving the quality and efficiency of the water supply and sanitation services is based on the positive externalities that these bring on health, education, the environment, city competitiveness and tourism, among others. Investments in aquifer recharge pilots have a demonstration value to show local federal officials, as well as private industrial users, the potential benefits of the technology. Successful pilot interventions can be scaled up in the VMMA.

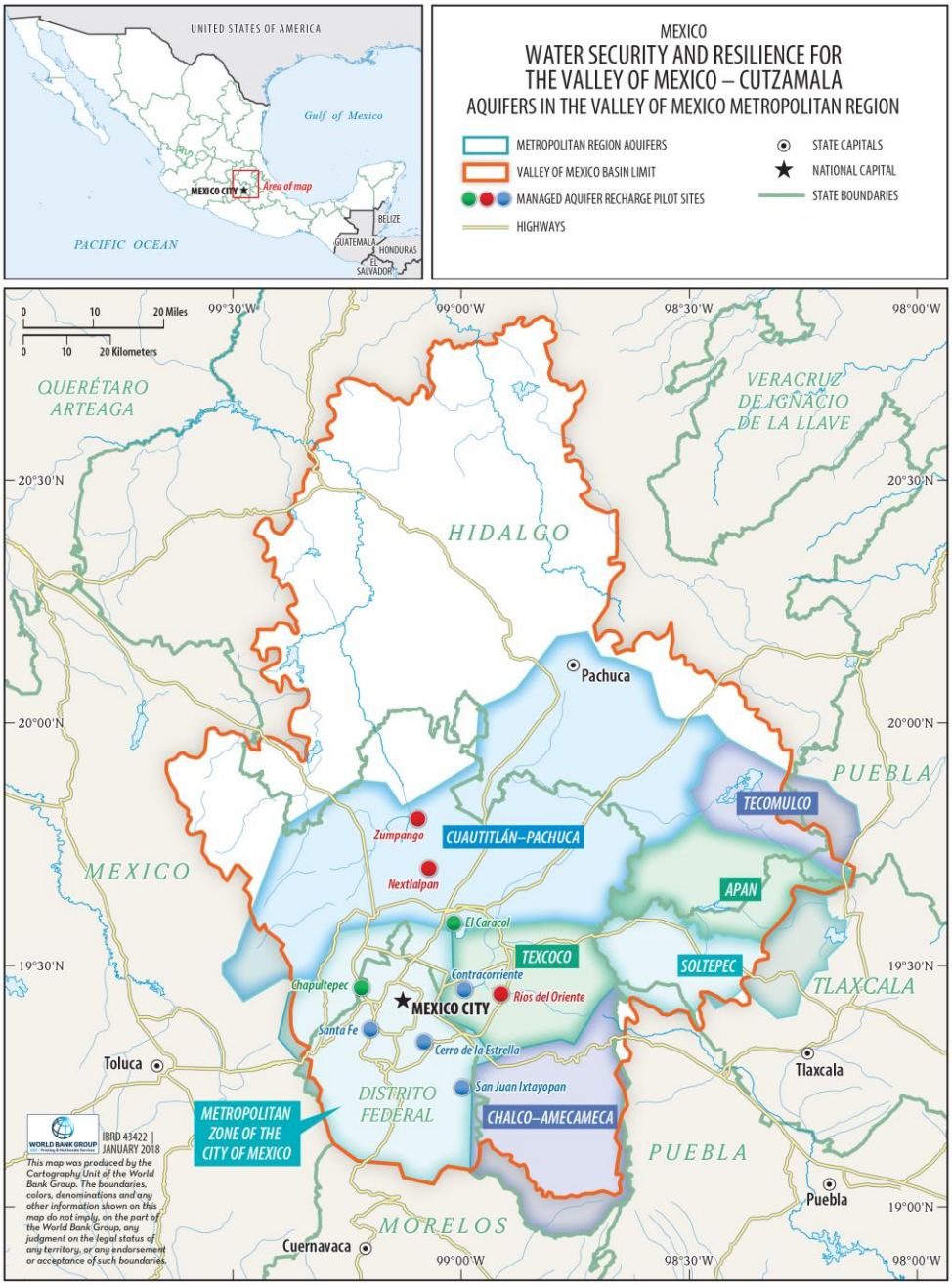
10. The investments in the Cutzamala System form a small portion of a larger system (over 300 km of conveyance infrastructure, eight dams, and a large water treatment plant) that are owned and operated by CONAGUA. Water quality and quantity delivered by the Cutzamala system are directly related to: (i) hydrological conditions in the basin, (ii) water usages for agriculture and drinking water, (iii) waste water discharges currently unregulated and (iv) land use coverage that impacts sediment load. Most of these variables are currently unknown and translate into important risks for private participation that would ultimately result into less favorable contractual arrangements. As a result of this situation private sector involvement is not seen as feasible at this time. Nevertheless, activities financed under Component 1 will provide valuable information to better quantify these risks in case the Government decides to promote a PPP scheme at a later stage.

Sector Financing

11. OCAVM is responsible for the operation and maintenance of the Cutzamala System, though which it delivers bulk water to SACMEX (for the Mexico City) and the State of Mexico (for the TMA). OCAVM calculates the per unit cost of water based on the operation and maintenance costs that it incurs in the delivery of bulk water—capital expenditures are not included in this calculation. SACMEX and the State of Mexico then reimburse the Federal treasury for the water is has received (based on the unit cost calculated by OCAVM multiplied by the quantity received). The Federal treasury in turn supplies fiscal transfers to OCAVM to cover its costs.

ANNEX 6: MAPS

COUNTRY: Mexico
Water Security and Resilience for the Valley of Mexico (PROSEGHIR)
Map 1: Location of Aquifers and Potential Recharge Pilot Sites in the VMMA



Map 2: Location of Cutzamala System in Mexico and Key Infrastructure Elements